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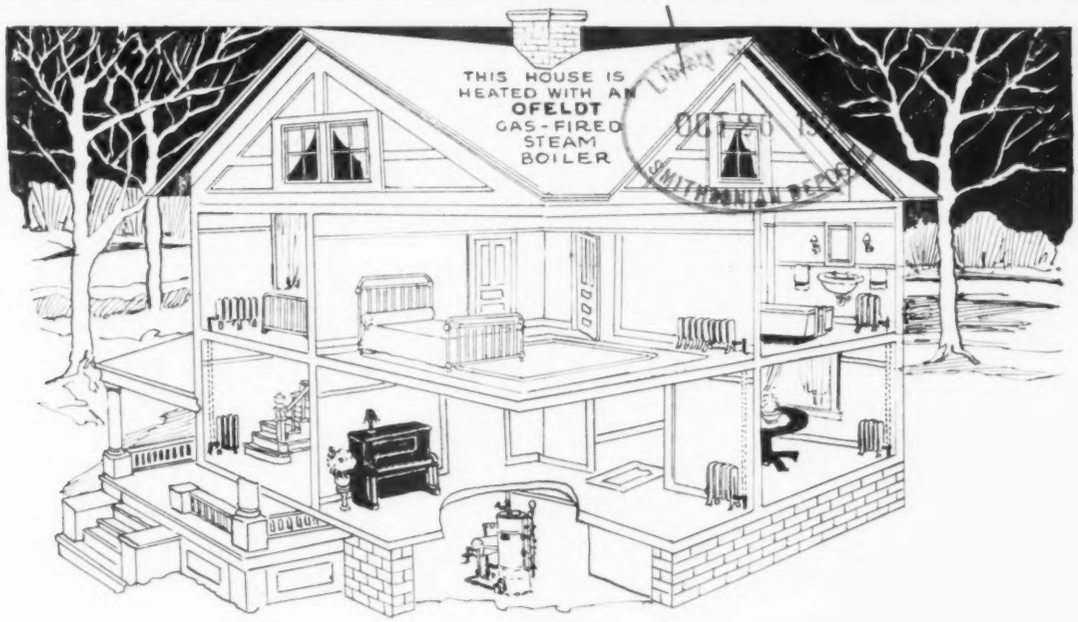

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Belgian-American Coke Ovens Corporation

THE BELGIAN-AMERICAN COKE OVENS CORPORATION has been recently organized as a United States Company. It has acquired all the patents and rights in the United States and Canada of the Franco-Belgian Coke Ovens Corporation of Brussels (Belgium) for the construction of the several types of Piette System By-product Coke Ovens and Recovery Plants.—

More than 1500 Piette ovens have been built and are in operation in several countries in Europe. Previous to the organization of the Belgian American Coke Ovens Corporation, a demonstration battery of Piette ovens has been erected at the coke station of the Laclede Gas Light Co., St. Louis, Mo., and is being successfully operated by the latter company after very minute tests and measurements of yields were made during thirty consecutive days.

Inspection of said demonstration battery is invited and complete information on the remarkable yields shown by same will be supplied on application.

The main characteristics of the Piette Ovens are:

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The regulation sections for the control of the gaseous currents are calculated before construction and exclude the need of numerous dampers and sliding bricks.

The simplicity of the regulation has been exceeded nowhere.

The checkerworks of the regenerators situated in the longitudinal galleries are crossed transversely by either the waste gases or the air, securing the equalization of the temperature in the whole battery without preventing the isolation of any one oven in case of stoppage.

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The BELGIAN-AMERICAN COKE OVENS CORPORATION is prepared to contract for the building of Piette By-Product Recovery Coke Ovens, with or without recovery of heat, also for plants for condensation and distillation of tar, production of sulphate of ammonia or concentrated liquor, recovery of benzol and carbolic acid, manufacturing of pure products: volatile alkali, benzene, toluene, xylene, naphthalene, phenol.

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The Design and Application of Atmospheric Burners

Notes Made as a Result of Careful Study

By THOMSON KING

The term atmospheric burner is meant to include all burners using the Bunsen principle in which a jet of gas at ordinary distribution pressures is made to entrain air from the atmosphere before reaching the zone of combustion, the gas and entrained air being then led through a mixing tube to the burner proper and burning as they emerge from the burner ports.

The use of this type of burner dates from 1855, when Bunsen devised the burner or, more properly, the mixer, that bears his name and revolutionized the burning of gas.

From the introduction of manufactured gas until 1855 gas manufacturers and users were content with open-flame burners, allowing the flame to spread out and expand until it could reach the amount of oxygen needed for combustion. This method necessarily resulted in a large low-temperature luminous flame and imperfect combustion, if the flame was confined or restricted in space. Bunsen showed that if the gas were allowed to draw in some air before the combustion zone was reached, the flame became blue and non-luminous, and at the same time much hotter and more concentrated, and that this flame could be used in restricted spaces, as under vessels, without imperfect combustion or the deposit of carbon.

We are sure that gasmen will agree that the article Mr. King has written is one of the most valuable that has been published in years. The data contained in it are of immense value and should certainly prove a mighty handy reference at all times.—Editor.

The Bunsen principle is now used to burn by far the larger proportion of all gas sent out by Public Utility Companies. The proper design of the burner and its parts is of great interest and importance to all makers and users of gas and manufacturers of gas appliances; in fact, to the whole industry. It is, however, a subject that until recently has never received the attention that it deserves. There has been very little trained or scientific investigation of the principles governing burner design. It has been very easy to build burners that would give fairly satisfactory results. They have been built largely on rule-of-thumb principles with very little thought as to whether they might be improved by a study of the principles governing their design. From the time of Bunsen's revolutionary invention until quite recently little or nothing has been added to our knowledge of burner design and very little has been written on the subject.

If the gas burners in general use were perfect or even uniformly good and efficient, this complacent and self-satisfied attitude might be justified, but as a matter of fact the burners that we see around us in every-day use are very far from perfect and in many cases distressingly inefficient, due to poor design or faulty application, nor is there any uniformity in the practice of the manufacturers. Good practice has not driven out bad practice, and we buy and use good and bad burners with little discrimination as to quality or efficiency. It is therefore evident that there is a large and fruitful field for investigation of ways and means for improvement of design, and for improvement in practice in application of burners after they are built.

The need for a better understanding of burner design is particularly pressing at this time, when tremendous increases in the cost of gas making have imposed higher rates and made more necessary than ever before, the highest possible efficiency in utilization.

Fortunately, such an investigation has already been begun. It had its beginning in suggestions by the industrial fuel committee of the American Gas Association and has been carried out by the engineers of the Bureau of Standards. The research and experimental work of Messrs. Berry and Brumbaugh and their assistants at the Bureau of Standards has been of the highest quality and will be of great value to the industry if properly studied, digested and applied. It now covers experiments on both artificial and natural gas burners and much of it has been made available

by publication. The writer wishes to acknowledge his indebtedness to this work for parts of the data presented in this article.

Since our subject is a large one and a clear understanding of terms is essential, we will, even at the risk of seeming too elementary, begin with a few simple definitions of what certain terms mean.

Definitions

The term "burner" will be used to designate the whole assembled appliance which handles the gas from where it leaves the supply pipe to the point of combustion.

"Burner Cock"—The cock or valve controlling the flow of gas from the supply pipe or manifold.

"Orifice"—The opening from which the jet of gas enters the mixing tube.

"Mixer"—The casting which holds in place the orifice and air shutter and encloses the orifice.

"Mixing Tube"—The chamber into which the jet of gas flows from the orifice and into which the primary air is drawn.

"Air Shutter"—The movable piece which controls the opening through which primary air is drawn into the mixer.

"Burner Head"—The part of the burner containing the burner ports and into which the air-gas mixture flows from the mixing tube.

"Burner Ports"—The holes in the burner head from which the mixture of gas and primary air issues and burns as it emerges.

"Primary Air"—The air drawn into the mixer by the entraining action of the gas jet.

"Air-Gas Ratio"—The ratio of primary air to gas.

"Secondary Air"—The air taken by the gas flame from the surrounding atmosphere to complete combustion. This will equal the difference between the total air needed to burn the gas and the amount entrained as primary air.

Principles of Combustion

It will be well to review briefly just what happens in our atmospheric burner before we proceed to discuss how we can make it perform its functions most efficiently. We must always remember that combustion is a chemical process consisting of certain reactions, the ultimate result of which is the combination of hydrogen and carbon with the oxygen of the air in definite proportions with the evolution of heat. The heat is the product that we desire and it is always our desire and object to direct as large a proportion of the heat evolved as possible to accomplish some definite result. The burner is the tool by which we endeavor to accomplish this object. Its perfection and success must be judged by how well it performs its work.

In building burners, we must deal with different kinds of gases with differing characteristics, which will influence the behavior of the burner. It is important for us to understand that for all gases that do not contain a large proportion of inerts, the volume of air necessary to burn a given volume of gas is very nearly proportional to the heat in the gas. In other words, the B.t.u. per cubic foot of mixture of air and gas in correct proportions for complete combustion is practically the same for all combustible gases, or mixtures of such gases. The following table shows the characteristics of most of the familiar gases and its last column illustrates the very important principle just referred to:

Combustion Data on Gases

Gas	Specific Gravity	B.t.u. Per Cu. Ft.	Cu. Ft. Air to Burn Cu. Ft. of Gas	Vol. Air and Gas Mixture	B.t.u. Per Cu. Ft. Mixture
H_2	0.0692	326	2.39	3.39	96.2
CO	0.967	323	2.39	3.39	95.3
CH_4	0.553	1,009	9.57	10.57	95.5
C_2H_2	0.898	1,477	11.96	12.96	114.0
Natural gas—Pittsburgh	0.55	1,084	10.27	11.27	96.0
Coal gas—rich	0.42	580	5.21	6.21	94.0
Coal gas—lean	0.40	510	4.43	5.43	94.0
Carbureted water gas	0.60	575	5.02	6.02	94.0
Blue water gas	0.60	295	2.35	3.35	91.0
Producer gas	0.81	144	1.05	2.05	70.0
Blast-furnace gas	1.00	91	0.67	1.67	54.0

What Happens in the Burner

When the burner cock is opened, gas flows through the gas orifice. Since the area of the orifice is much smaller than that of the pipe leading to it, the velocity of the gas as it flows through the orifice is much greater than in the pipe. The orifice velocity for 0.65 gravity at two-inch pressure is 113 ft. per second. The jet of gas leaving the orifice enters the mixer and flows through the air in the mixer. As soon as it leaves the orifice the jet begins to expand. The particles of gas moving in contact with the surrounding air entrain and carry with them particles of air; thus in the mixer we have the movement of an expanding gas jet and of entrained air. The mixture moves forward in the mixer tube and from the mixer tube into the burner head. The velocity of the gas jet after it issues from the orifice has been greatly reduced as it expands and mixes with the air and by the time the mixture leaves the ports of the burner the original energy of the jet has partly dissipated by friction and eddy currents, and partly converted into pressure head by creating a pressure in the burner head. The jets of air-gas mixture issue from the burner ports and burn from them with the addition of the secondary air taken from the surrounding atmosphere.

General Objects of Design

The ideal burner may be defined as that burner

which will make available for useful work the largest proportion of the heat units in the gas, and which at the same time will be reasonable in first cost, reasonably durable and entirely free from operating troubles. To attain these conditions are the objects of design. To restate them in the most general terms we are concerned with transferring the heat from the gas into the thing to be heated with as little loss as possible and with producing a burner that will give no trouble.

We will next inquire into the general conditions favoring high efficiency: First, it is evident that the reason the heat leaves the flame and enters the thing we are heating is because of the difference in temperature between them, and therefore the hotter the flame, the greater this difference, the steeper the temperature gradient, the more rapid the flow of heat and the higher the efficiency. It follows, therefore, that in general we should design our burner to give the maximum flame temperature possible. The maximum flame temperature would be reached when all the air necessary for combustion is admitted as primary air, but since this is a condition that we cannot attain with the gas pressures usually available, we must seek to make our primary air as large a proportion of the total air as possible. It is also important that, having developed as high a flame temperature as possible, that the flame be brought into intimate contact with the thing to be heated in order that the heat transfer may be effected with as little loss as possible. Of these two primary objects, the first may be attained by proper design and the second by proper placing of the burner.

Different processes would suggest burners of different characteristics to get the best results, and this is also true for different kinds of gases and different pressures; when, however, burners are designed for general use the best that can be done is to compromise on a good average and make them so that, with simple adjustments, they will give satisfactory results over widely varying conditions.

On the other hand, when the burner, as is often the case in industrial work, is designed for some particular application at a particular place, and for that only, the design may be modified to give the maximum results for the particular conditions under which we know the burner will operate.

The object of this article is not to present a complete treatise on the design of all kinds of atmospheric burners, but rather to state and define certain elementary yet important principles affecting the design of all burners and give certain data that may be useful in the design of particular burners. At the same time, to give a few rules that may be used as a guide in design work and a help toward standardization of practice, and a correction of some of the evils from which our present burners suffer.

When a burner is designed for general use, it is wise to remember that pressures may be decreased easily but cannot be easily raised, and that the same is true of capacity and air-gas ratio. We may therefore itemize the objects of design as follows:

For a given size and weight, the burner should have a maximum capacity; this means reduction in cost of manufacture and ease in handling.

The burner should be capable of operating with a high air-gas ratio. This means an intense, concentrated, high-temperature flame, small head room, perfect combustion and high efficiency.

The flame should be of uniform height on all parts of the burner.

The flame must not flash back when lighted or when turned down.

The flame must not blow away.

The burner must operate satisfactorily over a reasonably wide range of pressure and change in the composition of gas.

The burner must not become so hot as to unduly shorten its useful life.

It must be reasonable in cost, strong and durable.

In the attainments of the preceding qualities, we must never sacrifice other items, such as convenience, simplicity and safety.

Let it also be remembered that for certain work, all of the above qualities are not essential and that we must always consider our application thus—for a space heater, we do not particularly care for a high air-gas ratio or an intense flame; in fact, a yellow flame might suit our purposes as well, or better.

Having broadly defined the objects of design, we will now consider in more detail, the design of each part of our burner, giving when possible data that may be used in the design of specific burners.

The Burner Cock

For the control of the admission of the gas to a burner, a cock is undoubtedly superior in many ways to a valve, yet the use of globe valves persists on some appliances. The cock should be of ample size and strength. At present a great proportion of our burners are fed by cocks that are too small and poor service results. On this account, and also due to poorly made cocks, a very great proportion of the maintenance and complaint work of gas companies could be traced to burner cocks. In this simple and apparently unimportant detail of our burners, there is room for great improvement, which is especially needed now as the tendency towards lower heat unit standards is making the need for liberal sized cocks more important every day, and the high cost of labor makes it vitally important that maintenance and complaint work be reduced to the lowest possible point. The following table will insure cocks of adequate size The table is for straight cocks; angle cocks will have lower capacities:

Capacity of Burner Cocks

Nominal Size of Cock	Maximum Rate on Which Should Be Used
⅛	30 cu. ft. per hour
¼	50 cu. ft. per hour
⅜	80 cu. ft. per hour
½	190 cu. ft. per hour
¾	260 cu. ft. per hour

The Orifice

The function of the orifice is to allow the proper amount of gas to flow in the form of a jet into the mixer tube and to properly control the direction and form of the jet. The flow of any gas through an orifice when the pressures are small, as is the case with the orifices we are considering, is expressed by the familiar hydraulic formula, $v = \sqrt{2gh}$.

Where v is the velocity of flow through the orifice g is the acceleration due to gravity, equals 32.2 ft. per second, h equals the height of a column of the fluid necessary to produce a pressure equal to the orifice pressure. From this we can develop a formula adapted to the calculation of the flow of gas through burner orifices which, expressed in convenient terms, will be $Q = 1{,}658\ K\ A\ \sqrt{P \div S}$.

Where Q equals orifice capacity in cubic feet per hour A equals area of orifice in square inches, P equals difference of pressure between the two sides of the orifice in inches of water, S equals specific gravity of gas, K equals a constant depending upon the shape and type of the orifice and known as the coefficient of discharge of the orifice. This constant ranges from 0.60 to 0.95 for gas orifices.

From the above formula we see that the flow of gas through an orifice is directly proportional to the square root of the pressure and inversely proportional to the square root of the gravity, and will also vary with the type of orifice.

Orifices may be divided into two great classes which we will call sharp edge or thin orifices and channel orifices. Examples of the two classes are shown in figures 1 and 2.

According to a well-known principle in hydraulics, a jet of fluid contracts when it issues from a thin orifice, but if the orifice is lengthened so that it becomes a short tube or channel, this contraction of the jet is suppressed and the flow is increased. Of the two orifices shown in figure 1 the channel type will pass more gas, other things being equal.

The majority of orifices found in gas appliances are of the channel type; therefore, in presenting data for use in selecting orifice sizes, this type will be considered. The writer has carried out experiments with

Fig. 1
Sharp Edge Orifice

Fig. 2
Channel Orifice

a considerable number of the orifices found in everyday commercial use, and this investigation showed that the average value of the constant for the orifice as found in standard appliances is 0.90. That is where the length of the channel is about equal to the diameter of the orifice.

The writer has recently investigated three tables purporting to give the flow of gas through orifices; one of these gave values which were undoubtedly slightly too high. The next was very much too low, and the third was absolutely unreliable, in some cases having errors of several hundred per cent. The following table gives the flow of gas through commercial orifices. It is calculated on the basis of two inches pressure, 0.6 specific gravity and K equals 0.90.

Following this table, we give conversion tables by which the figures of the table may be readily converted to other pressures and other gravities.

Flow of Gas Through Orifice

Fraction	Dec.	Morse Drill Gauge Size	Area Sq. In.	Flow—Cu. Ft. Per Hr., 2 In. Pressure 0.6 Sp. Gr.
1/64	0.0156	..	0.00019	0.52
1/32	0.0312	..	0.00076	2.1
3/64	0.0469	..	0.00173	4.7
1/16	0.0625	..	0.0031	8.4
5/64	0.078	..	0.0048	13.0
	0.0785	47	0.0048	13.0
	0.081	46	0.0051	13.9
	0.082	45	0.0053	14.4
	0.086	44	0.0058	15.8
	0.089	43	0.0062	16.9
	0.0935	42	0.0069	17.8
3/32	0.0937	..	0.0069	17.8
	0.096	41	0.0072	19.6
	0.098	40	0.0075	20.4
	0.0995	39	0.0078	21.2
	0.1015	38	0.0081	22.1
	0.104	37	0.0085	23.2
	0.1065	36	0.0090	24.5
7/64	0.1093	..	0.0094	25.6
	0.11	35	0.0095	25.9
	0.111	34	0.0097	26.4
	0.113	33	0.0100	27.2
	0.116	32	0.0106	28.9
	0.120	31	0.0113	30.8
1/8	0.125	..	0.0123	33.5
	0.1285	30	0.0130	35.4
	0.136	29	0.0145	39.5
	0.1405	28	0.0155	42.2
9/64	0.1406	..	0.0155	42.2
	0.144	27	0.0163	44.4
	0.147	26	0.0174	47.4
	0.1495	25	0.0175	47.7
	0.152	24	0.0181	49.3
	0.154	23	0.0186	50.7
5/32	0.156	..	0.0192	52.4
	0.157	22	0.0193	52.6
	0.159	21	0.0198	54.0
	0.161	20	0.0203	55.4
	0.166	19	0.0216	58.8
	0.1695	18	0.0226	61.6
11/64	0.1719	..	0.0232	63.2
3/16	0.1875	..	0.0276	75.2
13/64	0.203	..	0.324	88.3
7/32	0.2187	..	0.0375	102.0
15/64	0.234	..	0.0442	120.0
1/4	0.250	..	0.0491	134.0
17/64	0.2656	..	0.0554	151.0
9/32	0.2812	..	0.0621	169.0
19/64	0.2969	..	0.0692	189.0
5/16	0.3125	..	0.0767	209.0
21/64	0.3281	..	0.0845	230.0
11/32	0.3437	..	0.0928	253.0
23/64	0.3594	..	0.1014	276.0
3/8	0.375	..	0.1104	301.0
25/64	0.3906	..	0.1198	327.0
13/32	0.4062	..	0.1296	353.0
27/64	0.4219	..	0.1398	381.0
7/16	0.4375	..	0.1503	410.0
29/64	0.4531	..	0.1612	438.0
15/32	0.4687	..	0.1725	470.0
31/64	0.4844	..	0.1843	502.0
1/2	0.500	..	0.1963	535.0

7/32	0.5312	..	0.2216	694.0
9/16	0.5625	..	0.2485	678.0
19/32	0.5937	..	0.2769	755.0
5/8	0.625	..	0.3008	836.0
21/32	0.6562	..	0.3382	923.0
11/16	0.6875	..	0.3712	1,013.0
23/32	0.7187	..	0.4057	1,105.0
3/4	0.750	..	0.4418	1,205.0
25/32	0.7812	..	0.4794	1,307.0
3/16	0.8125	..	0.5185	1,415.0
27/32	0.8438	..	0.5591	1,525.0
7/8	0.875	..	0.6013	1,635.0
29/32	0.9062	..	0.6450	1,759.0
15/16	0.9375	..	0.6903	1,883.0
31/32	0.9689	..	0.7371	2,020.0
1	1.000	..	0.7854	2,140.0

Multipliers to Convert Flow at 0.6 Gravity to Flow at Other Gravities

Gravity	Multiplier
0.30	1.41
0.35	1.31
0.40	1.22
0.45	1.15
0.50	1.09
0.55	1.04
0.60	1.00
0.65	0.96
0.70	0.93
0.75	0.89
0.80	0.87
0.85	0.84
0.90	0.82
0.95	0.79
0.10	0.75

Multipliers to Convert Flow at Two Pounds Pressure to Flow at Other Pressures

Pressure	Multiplier
1.00	0.70
1.50	0.86
2.00	1.00
2.50	1.12
3.00	1.22
4.00	1.415
5.00	1.58
6.00	1.73
7.00	1.87
8.00	2.00

The value of the adjustable orifice has long been a disputed question. We believe it may be answered by saying that the use of any adjustable orifice that operates by inserting an obstruction into or in front of the orifice, is bad practice and should never be employed. An orifice that opens and closes without obstructing the free access of gas to it is desirable under conditions where frequent variations of gravity, pressure or heating quality of the gas must be met, provided it is strong and free from mechanical troubles.

The Mixing Tube and Air Entrainment

The jet of gas leaving the orifice flows into the mixing tube. The function of this tube is to promote the entrainment of air and conduct the air and gas to the burner.

We have already shown that we should aim to design and build a burner that will entrain the maximum amount of air and that will operate satisfactorily on a minimum of pressure.

Again we see that the design of the mixing tube is a problem in hydraulics. We have a jet of one fluid moving in another. We can get the best results by observing certain rules as to the shape and proportions of the various parts. The shape best suited to the mixing tube is the form of the Venturi tube. This form has the following advantages: It will allow the expansion of the gas jet, the entrainment of air and the mixing of the two with the least loss of energy, due to friction and eddy currents. This means maximum capacity for the burner and a maximum pressure in the burner head which insures maximum velocity of air-gas mixture issuing from the burner ports and consequently a minimum tendency to flashback troubles. The general form of the properly designed mixer is illustrated in figure 3. This may be spoken of as the Venturi type. It narrows to a point of maximum contraction a short distance from the orifice and expands along gentle lines to the full area of the tube. This form gives the greatest injecting power to the gas jet and most efficiently conserves and applies its energy. It will give the maximum pressure in the burner head and the best operating characteristics. A general idea of the best design of mixing tube is given in figure 3.

The determining dimensions of the tube might be expressed as a function of the cubic feet of gas burned per unit of time, but for the sake of simplicity and as an aid to design, it is more convenient to express them as functions of the diameter of the fully expanded tube which will be determined by the amount of gas to be burned and which we designate as "D."

The principal dimensions are then D equals diameter of point of greatest contraction equals 0.5 D.

L equals length of expansion tube equals 4.7 D.

l equals distance from orifice to point of greatest contraction—1.5 D.

The included angle between the sides of the expansion tube should be about 6 deg. and the transition of the sloping lines to the straight sides of the tube should be rounded.

In case of cast-iron burners, the proper shape can be readily given to the mixing tube when the pattern is made, and the cost of making the correctly shaped mixing tube will be no greater than an incorrectly shaped one. In the case of burners made from standard wrought-iron pipe, the proper shaped mixing tube may be obtained by the insertion of a short tube of the proper shape into the wrought-iron pipe.

In any case, whether a Venturi shape is used or not, the length of the mixing tube should be not less than five times its full diameter, and six is better.

For an able and thorough discussion of this very important question of the injecting power of a jet of gas, the reader should consult the work of the Bureau of Standards on the design of atmospheric burners already referred to. It must suffice here to point out a few of the more important principles and state a few rules as briefly as possible.

The injecting power of a jet of gas is proportional to its momentum. That is, the product of its mass

(*Continued on page* 370.)

Sale of Gas Furnaces for Heat-Treating Steel and Forging*

Offers Large and Profitable Field to Gas Companies

By JOHN B. REDD, Beacon Light Company

The sale of gas furnaces for the purpose of heat-treating steel, and especially for light forging, offers a large and profitable field as a source of revenue to the gas company. To the individual who is handling the sale of such furnaces is offered the golden opportunity to make appreciative, lifelong friends, both for himself and his company, as the salesman handling this class of merchandise must keep his wits about him at all times and consider his customer's business in the same light as if he was financially interested in the business.

The sale of gas furnaces for this line of work should really be considered more on the basis of selling service rather than taking an order for so much merchandise on which a certain percentage of profit is made, as it is not the sale of the furnace which is going to make a success of the installation but the actual service rendered after the furnace is in operation. This needs more than an occasional call by a gas fitter to see that the furnace is being operated satisfactorily and the burners are properly adjusted, as the confidence of the user should be held to the extent that he will telephone the industrial department when any change is considered necessary as to temperature, burner adjustment and repairing of the furnace; or, if it is desired, to heat-treat a different grade of steel than that which is being worked upon. If such information is requested by the user from the industrial department there cannot be anything except a close, friendly feeling between the user and the company which is selling him the fuel.

The heat-treatment of steel covers an extensive field, and volumes have been written, and many more volumes will be written, upon this very interesting subject, as every observing metal worker learns something new regarding his work almost every day. Perhaps what is new to him might be old to other metal workers, as how seldom do we really discover something entirely new that someone else does not know about or perhaps put into actual practice many years ago! This is one trouble with the sale of gas furnaces and other industrial appliances to-day; and if we are not having trouble in selling appliances of this kind I would like to know it, as I have yet to find the gas company official who would make the statement that his company was supplying gas for fuel to all heat-treating furnaces in his district, or, in other words, that his company actually had 100 per cent of the business to which it was entitled to, and, in fact, to the business where oil or hard fuels were being used, where if modern gas furnaces were substituted the cost of heating would be considerably less and the finished products superior to the parts heat-treated by oil, coke or coal.

Generally, steel is divided into two classes and commonly referred to either as carbon steel or high-speed steel. Low-carbon steel is soft and cannot be hardened for cutting purposes, while an increase of carbon content not only makes for greater cutting endurance but does not warp and crack easily; it is of finer fracture and offers more resistance to machining.

The metal worker must be able to select the right kind of steel to be heat-treated for a particular purpose, and keep in mind at all times that the heating is the most important operation to insure a satisfactorily finished product.

Usually Considered Under Different Headings

The heat-treatment of steel is usually considered under different headings, such as forging, which takes in many and varied lines of work; tool making, tool dressing, or the manufacture of many parts of automobiles and hundreds of parts for other kinds of machines. Then we have drop forging, which is really machine blacksmithing, and the products of the drop-forging industry are now used in a great variety of the mechanical arts.

Drop forging was developed about 1853, when Col. Samuel Colt adopted these machines to make parts for firearms. This method has shown a marked advancement within recent years, and many wonderful operations are being done with the combined use of the drop hammer, properly treated steel dies and modern gas furnaces. Practically all cutlery is produced by drop forging, while razor blades are made in the same manner, afterwards forged down by hand to the rough size, then stamped and hardened and ground to the proper size and shape. Even in grinding, great care must be observed in order not to heat the steel so hot as to draw the temper, which gives an idea as to the care necessary in heat-treating steel parts.

Steel of 1.5 per cent carbon content is suitable for planing tools, drills, razors, etc. It is spoiled if overheated, and the maximum working temperature should not exceed 1,450 deg. Fahr. The temperature at which carbon steel can be treated increases as the carbon content decreases, and for forging, annealing or hardening carbon steel the temperature ranges from 1,400 deg. Fahr. to 1,700 deg. Fahr.

The hardening of steel parts is accomplished by heating from 1,500 to 1,600 deg. Fahr. and suddenly cooling, and the degree of hardness varies with the speed of cooling. The exact temperature depends upon the material being treated, and when the high temperature is used the parts are allowed to soak in the heat for a shorter period of time than when treated at a lower temperature.

Various styles of oven and crucible furnaces are designed especially for this purpose. For case-hard-

*Paper read at Southwestern Gas Association convention.

ening or carbonizing, the pieces to be treated are packed in metal carbonizing boxes and surrounded with carbonizing material, or gas is allowed to come directly in contact with the parts to be case-hardened and the carbon from the gas allowed to penetrate the parts being treated to the desired depth. After heating the desired length of time at a given temperature, the parts may be immediately quenched in a bath or the parts may be allowed to slowly cool in the metal containers, removed, again reheated in a semi-muffled furnace, and then quenched in a bath of water or oil, depending upon the material and the purpose for which it is to be used.

The Operation of Annealing

Annealing is the operation of removing hardness from metal parts by careful, uniform heating and slow cooling, which leaves the steel in its softest and toughest condition. This process is used for restoring the properties of steel parts which have become brittle through excess of strain caused by stamping, etc. Parts to be annealed must be treated in furnaces so designed to keep air from the parts, which causes oxidation, and the success of the work depends almost entirely upon the time of heating and the temperature of the furnace.

Tempering modifies the hardness of steel by reheating and allowing to cool slowly or rapidly, which increases the toughness and ductility but reduces brittleness and hardness. The temperature required for tempering ranges from 420 deg. Fahr. to 750 deg. Fahr., and in certain cases even higher temperatures are used.

Tempering steel is really the fine art of the metal worker, and this work is done at such varying temperatures that the furnace man must know the grade of steel being treated and the purpose of its use.

Tool tempering is usually done in an oven type of furnace, the parts being heated to a certain color, removed, and quenched in water. Other mediums used are oil, lead, air, hot sand, salt and other substances, which are heated to a certain temperature and the parts emersed or placed in the medium for a given period of time.

Much work has been done within the past few years by the leading manufacturers in developing the sale of their furnaces, but few changes have been made in the general construction or type of furnaces for the average run of work within the recent years. There is always room for improvement, but I am satisfied that most heat-treating furnaces which are now offered for sale by reputable manufacturers are quite efficient to satisfactorily do the work for which they are designed, to enable us to get our share of the heat-treating business if the right furnace in each case is sold for the purpose for which it was designed. You can rest assured that the manufacturers have not only designed and redesigned furnaces which are catalogued before they are offered for sale, but they have made successful installations of all such furnaces.

An up-to-date industrial fuel department of a gas company can be compared with a motorized fire department of any of our modern cities, and the increased speed obtained in making successful furnace installations by employing modern and efficient means through the industrial department will increase the heating business over the old methods as much as the speed of a fire department is increased by displacing the faithful but slow horses for modern motorized fire-fighting apparatus.

The furnace manufacturers and the superintendents of many industrial plants started some good work during the late emergency, and if the gas companies fail to keep up this work they will lose much good revenue. It cannot be expected that the manufacturers will take over all the burdensome and expensive work pertaining to the sale of heat-treating furnaces or that the retail appliance companies will sell very many furnaces on the margin of profit obtained from this class of merchandise, except in the most profitable territory. The users of such furnaces will most certainly have to be sold. They will not come into our offices and order furnaces, but are waiting for you to go out and tell them the story.

Every dollar judiciously expended by a gas company toward developing high-class industrial appliance salesmen and in selling heat-treating furnaces will bring in many dollars in increased revenue and will go far toward establishing for the gas company the good-will of the best business men of the community. The positions in the industrial department should be filled from the ranks of the appliance salesmen and solicitors, and this should be an incentive for the younger members of the sales force to put forth their best efforts at all times and for them to realize that it is to their advantage to really study the heat-treating business.

The best sales argument possible to use in selling a heat-treating furnace is to be able to say that a certain concern in the same town is using a similar type of furnace, and to be able to have that user so well satisfied that he will highly recommend gas as a fuel to any prospective user.

To secure your share of this class of business is simply a case of continued efforts along well-defined and proven lines. Hard work, common sense, honesty, with true facts intelligently presented by well-informed salesmen to prospective purchasers of heat-treating furnaces, will sell furnaces and keep them sold.

Gas Franchise Voted Down

A proposition to grant a twenty-year franchise to the Jackson County Light & Power Company, the gas company that furnishes gas to the city of Independence, Mo., was voted down at a special election Oct. 11. The vote was: For the franchise, 635; against, 846.

The company has sought to have its present franchise, which has still five years to run, extended to twenty years, contending that it must have the long-time lease in order to finance the needed extensions and improvements. The city council has refused to grant the extension, and upon the insistence of the company put the matter up to the people, with the result announced above.

Improving Gas System

Red Bluff, Cal.—Approximately $24,000 is to be expended by the Pacific Gas & Electric Company in the near future on improvements for its gas system in Red Bluff. H. B. Heryford, manager for the company's West Side division, has just received authorization from the head office for the work to be done, and he said it will be started probably in the middle of October.

Vital Factors Affecting Central Station Industrial Gas Business

Report of the Industrial Fuel Sales Committee of the A. G. A.

For many years the representatives of the gas companies, and particularly those that were specializing in industrial sales, have educated the manufacturers in the localities in which they operated to the advantages of a gaseous fuel. The manufacturers of gas appliances, and appliances that require a fuel for their operation, have contributed in no small measure toward the popularizing of gas as an industrial fuel. The intensive methods of production that characterized the last ten years of industrial development, injected additional impetus to the use of a flexible fuel. The demand for an adequate fuel forced many industries during the war and after the war period, to adopt central station gas as a fuel, in spite of the high cost, because it was the only one available. The natural gas industry has also contributed to the education of the manufacturer to the use of gas. Rapidity of production, accuracy of temperature control, automatic furnaces, better appliances, increased cost of labor, value of increased production, etc., have all added their quota towards making gas the most desirable of all industrial fuels. To-day every gas company has on its lines a number of customers that are purchasing gas fuel in prference to solid or liquid fuels. The amount of business that they have depends in a large measure on the rate they sell their gas for, the size of the plant they supply and the local conditions of the manufacturer that uses it; but in a general way the same character of business is obtained in every community, large or small, with very little effort. The great bulk of this business is non-competitive and consists mostly of industrial applications in which the cost of the fuel is far outweighed by the advantages gained in using it. In fact, in most of these applications the manufacturer can only obtain the desired results with a gaseous fuel. Even though the manufacturer realizes that gas from the isolated plant would be cheaper than using central-station gas, he immediately dismisses this thought from his mind because of the fact that his consumption is not large enough to warrant the installation of a gas plant. All this business, such as restaurant business, candy furnaces, hotel business, applications in small industrial furnaces, etc., represents business all in the non-competitive classes and is the business that the central station will maintain regardless of the higher cost of central-station gas in comparison with other fuels.

The members of the committee which will present this report at the convention are: Frank F. Cauley, Horace H. Clark, Thomson King, Robert E. Ramsey, Carl J. Wright and Henry C. Loebell (chairman). We believe they are entitled to a vote of thanks from the entire industry.—Editor.

All our industrial business, however, is not in the non-competitive class. The most profitable portion of this business is in a class that is competitive, and which we shall ultimately lose if we cannot compete on the basis of cost with the other fuels. This business represents our large industrial consumers who use large amounts of gas and where the cost of fuel is a very large factor of production expense. In order to get the best interpretation of the industrial fuel situation as it is to-day, let us look into this matter from the point of view of the manufacturer.

The manufacturers using fuel for industrial purposes appreciate the value of gas and regard it as most desirable. The great obstacle that was apparent years ago when the manufacturers were opposed to the use of gas because of their inexperience in its use, has been entirely overcome and the education carried out in all these years has convinced them that from the standpoint of a permanent, flexible and efficient fuel, gas is most desirable.

Years of experience in the industrial fuel business leaves no doubt but that the average manufacturer, using large quantities of fuel, will eventually have to use gas, no matter where he gets it. Intensive methods of production that characterize modern industry demand of him that he use a fuel of flexibility, such as gas only can give him. Inability to obtain this fuel from a central station will force him to look around for the best process that he can get to make the fuel himself. Every industrial plant that has had experience with fuel oil, coal, coke, or even electricity, in the past will ultimately be a gas user, whether this be applied from the central station or manufactured on the premises.

A Question of Cost

We therefore find that the apparent great obstacle; namely, the acceptance of our product as a desirable fuel, has long been overcome. The future for our business is no longer a matter of advertising, pub-

licity, acquainting the manufacturer with the value of our product, or anything of that sort. The present and future of our business lies in the solution of a more material factor—the reduction of the cost of our product to the consumer.

We are now in a period of business reconstruction wherein industry is doing everything it possibly can to cut production costs. A large amount of our industrial business was obtained when industries were forced to use central-station gas because it was the only fuel available. To-day, every industry is analyzing its costs and attempting to lower its expenses. Every large industry in which fuel is an important item of expanse, is figuring on displacing central-station gas with a fuel of lower cost. Those industries which necessarily have to use a gaseous fuel are looking into prospects of putting up isolated gas plants. Manufacturers that do not require gaseous fuel are taking advantage of the low price of oil. Those are the reasons that explain the fact that we are constantly hearing and reading about this and that company making negotiations for an isolated gas plant and giving up central-station gas.

The cause is not due to the undesirability of our product. We know that the manufacturer is well pleased with the results obtained in using central-station gas and the service which the company supplies, and that in many cases, he is willing to pay a premium or slightly higher price for our product than for a competitive fuel. However, with conditions as they are to-day, where our gas costs from 50 to 200 per cent more than other competitive fuels, the manufacturer has only one recourse and that is to discard our product for a cheaper fuel. In other words we are continually losing our biggest and most profitable customers because of the fact that our price is not right. The tendency of our large industrial customers, instead of being on the increase, is rather towards a slow and gradual decrease in number. All this means that if central-station gas is to become a successful industrial fuel, it must compete on a basis of cost with our other fuels. Our success is largely dependent on our ability to sell our product in competition with other fuels.

The basis of competitive cost is also important. The comparison of gas with other fuels is not to be made on a basis of pounds, cubic feet, or even heat value. The manufacturer is interested in the cost of the different fuels on the basis of a unit of plant production. The fuel that will melt a pound of metal, or treat a pound of steel at the lowest cost, is the fuel the industrial customer will purchase. The cost of fuel per unit of production is therefore the proper basis of fuel cost comparison.

The vital problem with which we are concerned is to lower the cost of fuel to the consumer, to make a dollar's worth of central-station gas do more work than a dollar's worth of any other fuel. The success of the industrial fuel business and ultimately the success of the gas industry is entirely dependent upon the solution of this problem. If we let things stand as they are to-day we not only close the door on all our future business, but we shall continue to lose all those large industrial customers who are able to build their own isolated gas plants, or use solid or liquid fuel. Under these conditions, our industrial business will simply fall back to the position where we shall be limited to only the small requirements in every community, such as restaurant and hotel business, and other small industrial applications.

On the other hand if we can find the way and means to give our industries our product at a much lower cost, we have an unlimited future before us. We know that if the price of central-station gas is right, every industry using fuel becomes a prospect to whom we can sell our product. With this thought in mind, your committee has endeavored to analyze the problem and segregate the factors which affect the cost of gas per unit of finished product, and by this means offer constructive suggestions which shall help the industry in overcoming our present difficulties and entering upon a career of assured prosperity, expansion and success.

The cost of central-station gas per unit of finished product is made up principally of three factors, which are: First, the cost to manufacture gas; secondly, the manner in which we segregate the costs of supplying our service, which form the basis of our industrial rates, and thirdly, the efficiency with which we apply and utilize our gaseous fuel.

Proper Industrial Rates

The present and future of our industrial business is largely dependent upon the policy and attitude we adopt in regard to rates. In order not only to be able to increase our business but to also maintain our present large industrial consumers, we must definitely establish a system of industrial rates which will make it possible to compete on a basis of cost with other industrial fuels. In the realization of this thought we can be well guided by the experience and success of a much younger industry, operating in a parallel field, which has successfully solved this problem; i. e., the central-station electric industry.

The central station began with rates which gave them little or no profit upon the small domestic customers but which made the industrial load yield enough profit to carry the whole business and make up the deficit. Of course, the natural thing happened. Isolated electric plants sprang up like mushrooms all over the country because it was easy to see that any industry could generate its own electricity cheaper than the central station sold it for. True, the unit of electricity generated by the isolated plant cost more than a unit generated at the central station but the customer did not have to stand any cost of other unprofitable business when he ran his own isolated station and therefore he saved.

Lowered Industrial Rates

The central station soon realized its unfortunate predicament and lowered its industrial rates, so that it could successfully compete with the isolated plant. At the present time privately owned generating units have almost entirely disappeared. In order that these results might be accomplished, it was necessary for the central station to make a rate such that the industrial customer could purchase a unit of energy at approximately one-fourth the rate charged the domestic customer. Under such a rate the electric station is able to satisfy its industrial and domestic customers and continues to make a profit on each class of business.

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Compulsory Coke Sales a Burden

By-product Operators Face Serious Condition

The most serious burdens of all by-product coke operators at the present time are compulsory sales at prices far below cost and the keeping on hand of large supplies of coke, which absorb working capital needed for the use of other parts of the business. This is the summary of conditions now confronting the coke business, as set out in the last of a series of public statements, made during the past month by the Citizens Gas Company, of Indianapolis. Recently this company was granted a 50 per cent increase in rates for its gas by the Public Service Commission of Indiana and the by-product coke situation entered materially into the considerations under which the increase was granted.

Since that time the company has been attempting a very elaborate campaign of education of its patrons to the dire distress that threatens all by-product coke plants, because of the unusual post-war conditions. In the last of its statements, the company tells its public:

"We have covered with some detail the leading problems connected with the marketing of our coke —attempting particularly to answer the numerous questions on that subject which have been raised in Indianapolis.

"In brief we have shown—

"1. That the maintenance of a low gas rate in Indianapolis requires the production of so large a volume of coke as to make it necessary to market large tonnages far from home.

"2. That we have found that the most efficient and economical method of reaching this wide market was through a sales agency which has a large organization throughout the territory which we must serve and handles other products which are wanted by the same trade that takes most coke. In this we have found that our policy is the same as that followed by practically all other by-product coke producers.

"3. That we have succeeded in developing the by-product coke business of Indianapolis from nothing in 1909 to a half million tons in 1920.

"4. That it is necessary to sell our coke in highly competitive markets, but that we have been able to establish the reputation of our product so that our metallurgical coke commands a substantial premium over standard brands.

"5. That a certain portion of our product is best adapted for use as domestic fuel and that our market for this, both here and elsewhere, has steadily broadened, except for the check to our domestic business caused by Government orders and coal shortages.

"6. That we have found that both our own interests and those of our Indianapolis consumers are best served by marketing our local domestic coke through the local coal dealers. Not having capital sufficient to go into the retail business ourselves, and not believing that gas consumers would want to carry an unprofitable coke business for us, we have maintained a price policy in accord with sound commercial principles—that is, we have endeavored to secure remunerative prices, yet keep them as low as possible in order to promote the business.

"Although we have generally met with a fair measure of success in the conduct of our coke business, we have met with great difficulties in times of industrial depression. Especially at the present time, we find our manufacturing customers unable to take their customary tonnages because they cannot sell their own products, while domestic fuel buyers are reluctant to make purchases for next winter because they recall the plentiful supplies of fuel which could be obtained last winter and hope that prices and freights will decline before next winter. Present sales at prices far below cost and large stocks which absorb working capital are the serious burdens of all by-product coke operators at the present time.

"We have discussed these coke problems in great detail because of apparent public interest in them, but there are other problems of the industry of no less vital (though for the moment less pressing) importance for the gas consumers of Indianapolis. We invite the consideration of the public to some of these further problems of the intricate business on which a cheap gas supply must depend."

Coke Experiments Successful

Washington, D. C.—The obtaining of a good grade of coke from coals which seemed devoid of any coking property has been accomplished by investigators at the University of Illinois, Urbana, Ill., working in co-operation with the United States Bureau of Mines, by the employment of a specially devised low-temperature coking process. As a result of the process, valuable by-products, in the way of ammonia, gas and tar, are derived.

The experiments were undertaken in connection with an investigation by the Bureau of Mines of the smoke problem at Salt Lake City, Utah. It was found that coke was regularly obtained from only a few coals tributary to the Salt Lake City district, and if the use of coke, a smokeless fuel, was to be increased in that city it would be necessary to demonstrate the possibilities of coking coals not regularly used for that purpose. Six coals from various Utah districts were tested.

Although, so far as present standards of coking indications are concerned, the coals tested seemed quite non-coking, treatment by the methods devised by Prof. S. W. Parr, of the University of Illinois, resulted in a yield of good coke amounting to approximately 60 per cent of the coal employed. The coke is dense and of good texture, and seems adapted to use as a domestic fuel and for metallurgical purposes.

The results of the investigation are of twofold importance, indicating the possibility of coking many coals not generally considered to have coking qualities, and also constituting a factor in the solution of the smoke problem in communities not favorably situated for the obtaining of smokeless fuel.

As the Journal Views It

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Industrial Fuel Sales

The report of the Industrial Fuel Sales Committee of the American Gas Association, which is published in this issue of the AMERICAN GAS JOURNAL and which will be presented at the convention next month in Chicago, is a splendid contribution to the thought on this subject. The recommendations that are made by the committee are all practical ones, and one which we feel sure will appeal to the industry as a whole. There can be no doubt that the committee is on the right track when it says that great efforts must be made if we are to hold the industrial business which we now have and attract other business.

Surely the entire industry will agree with the suggestion that industrial users of gas are entitled to a better rate than domestic consumers, simply on the basis of wholesale demand versus retail demand. This is a question that must come up for decision, and, as pointed out in the report, the American Gas Association has a great opportunity in going on record and then in forcing action on the part of the regulatory bodies of the different States. There are many users of gas for industrial purposes who have been forced either to take definite action in providing for themselves by means of their own plant or who are now contemplating such a step. It can be seen easily that such action will result disastrously to the industry if it is allowed to continue. But the only remedy that we have to offer is in reduced rates, and the only way that this can be done is for the regulations under which we now operate to be changed. Of course, it is not possible for all companies to reduce their rates, even at a risk of losing the business, for such a reduction would mean courting disaster from another source.

There is, however, one point on which common ground can be found, and that is in regard to the B.t.u. content of gas. At present, as pointed out in the report, the situation is a ridiculous one, for the present standards that seem to be almost universally insisted upon are wasteful and inefficient, to say the least. But that is due principally to the present method of forming regulations and of enforcing these statutes once they are on the books.

As pointed out previously, the report of the committee is a constructive one, and we hope that every reader of the AMERICAN GAS JOURNAL will study it carefully. There should be a great deal of discussion at the convention after the paper is presented, and it is to be hoped that from the thought that is offered there will come a decision that will sweep aside all of the obstacles now confronting us and will result in great progress in the future.

The Subject of Taxation

The present session of Congress will pass a tax law that will be operative for the next twelve months, at any rate, and may be the basis for taxation in the future, at least as long as the national administration remains in the hands of the same political party. In connection with this legislation there has been a great deal of discussion regarding tax-exempt securities, and many "feelers" have been put out by those entrusted with this important work. In many cases there has been an immediate response in the form of a declaration of public opinion either supporting some features of the proposed measure or condemning it. This has resulted in a changed attitude, at least for the time being.

We believe that the gas industry is as vitally interested in the proposed tax measure as is any other body of citizens; and certainly we are, from the standpoint of capital involved. Anything that is going to affect the market for our securities or their marketability is something that we must watch carefully, and it is the belief of the AMERICAN GAS JOURNAL that the impending measure will vitally concern us. It will do no harm to watch it, at any rate.

In discussing the tax measure there is a subject that is closely allied in which every gasman is interested. It has been stated on numerous occasions that the gas industry maintains a paid lobby at Washington solely with the purpose of influencing legislation and blocking laws that would be derogatory to us. When this report first gained the light of day the AMERICAN GAS JOURNAL made a superficial investigation and was convinced that no such organization existed. Lately, however, the report has again been circulated, and has been given credence by many who are only too ready to believe that the gas industry is composed of those who are ever willing to gain an advantage at the expense of the public.

We believe that our source of information that no lobby under any guise exists is reliable. We are again going to investigate, however, for we feel that such statements should be nailed promptly. If any

body purporting to represent the gas industry is active in Washington we believe the companies that go to make up this field should be promptly informed and effort made to drive these people out of business and away from their sinecures.

As has frequently been pointed out in these columns, it is unnecessary to have any such body; in fact, the best way to handle any pending legislation is from a local standpoint and for local companies and executives to take up with their elected representatives the question involved. There is no need for secrecy nor for meeting in dark corners. If there is secrecy the AMERICAN GAS JOURNAL would like to hear of it, and we can be depended upon to turn the full light of publicity upon it. Those who meet under cover of darkness have no place in this business. In other words, we want no tricksters, and we can't have them and continue to exist. We sincerely trust that no one has been supplying money for the maintenance of a gas lobby in Washington. If so, they have been badly fooled and have been wasting their money. And this is something that we cannot have, for it will react unfavorably on the industry.

Voting Against Municipal Ownership

Recently the voters of Lowell, Mass., were asked to decide the question of whether the city should purchase and operate the local gas plant. This special election, with this question as the only one to be decided, resulted in an overwhelming vote against municipal ownership and operation, and showed once more that there is little desire for political control of gas companies.

Massachusetts has always been regarded as being more or less in sympathy with municipal ownership and operation of utilities, and the fact that this decisive vote was taken would seem to show that experience has taught the residents of that State the fallacy of providing political office-holders with added "jobs" to be awarded to the faithful.

The gas company at Lowell has had an interesting career during the past few months. It was only a comparatively short time ago that the men went out on strike because of wage reductions, which were in line with the demand for decreased rates. The company maintained its stand and the men were decisively defeated. Many of them applied for their old jobs, but were met with the response that the company had nothing to offer, inasmuch as the men had failed to keep their faith with the company and, through the company, with the public. The strike was characterized with some violence, which also served to react unfavorably on the strikers.

It was believed that the movement for a special election was caused by propaganda put out by the strikers, and the result would seem to bear out this theory.

An interesting side light on the election was a vote that was taken by the local chamber of commerce just before the election. Although only a small percentage of the members voted, the result forecast the way the election would go. Thus it would appear that the business men of the town have very decided views on the subject. Perhaps the result of this movement will have its effect on other communities where politicians have so far forgotten the real reason they were elected to office as to attempt to force municipal ownership on the people. It is a dangerous matter to play with, as politicians will learn after it is too late.

The Design and Application of Atmospheric Burners

(*Continued from page* 363.)

and velocity. Since we desire maximum entraining power, it follows that we should always conserve our pressure behind the orifice and use as small an orifice as possible. It also follows that the heavier the gas, the greater proportion of air we can entrain. The following rules are taken from the report of the Bureau of Standards and show the relation between pressure, gravity and entraining power:

"Where the gas rate is increased by change of pressure, the momenta of the gas streams are directly proportional to the pressures.

"Where the orifice is adjusted to give the same gas rate under the same orifice pressure, with gases of different gravity, the momenta of the gas streams are proportional to the square root of their gravities.

"The relation between the momentum of the gas stream and the momentum of the stream of the mixture is always the same for any one burner, irrespective of orifice pressure, gravity of gas or the volume of the mixture going through the burner.

"When the pressure is changed to give the gas rate for gases of different gravity, the air entrainment is proportional to the gravity.

"The pressure in the burner increases directly with the increase in the momentum of the stream of mixture.

"If a change in gas pressure or gas rate should cause a considerable change in the temperature of the burner, the volume of air injected would be slightly different from the calculated values for the new condition, and there would not be quite the exact agreement between the above stated relations."

The results that can be obtained by taking cognizance and giving proper consideration to the laws stated above, and by providing the proper shape and dimensions for the mixing tube of a burner, are truly remarkable. Most of the range burners in general use have mixing tubes in which some attempt has been made to give a correct shape but apparently without much exact knowledge of just what governed the results desired. Most of our industrial burners have straight tubes with no attempt at the proper shape.

The writer has taken a burner having a straight mixing tube, and by the insertion of a crude tube of

sheet iron of approximately the correct shape, has increased the capacity of the burner 20 per cent, or by keeping the rate of gas constant has improved the flame characteristics, obtaining a much sharper and more concentrated flame. If more attention were paid to the mixing tube and the phenomena that take place within it, we could very greatly improve our burners.

The Burner Head and Burner Ports

The gas-air mixture having left the mixing tube, now enters the burner head and emerges from the ports. To obtain the best results, the ports must be of the correct size and must have the correct arrangement and proper spacing between them; also, it is most important that the proper relation be maintained between the total aggregate area of the ports, the amount of gas to be burned and the cross-section area of the burner. If the total port area is too small, the injecting power of the burner will be low; if it is too large, there is danger of flash-back. Since we are designing for a burner of maximum injecting power, we may adopt the general rule that the total port area should be as large as it can be made without incurring danger of flash-back.

Since flash-back occurs when the velocity of flame propagation exceeds the velocity at which the mixture issues from the ports, and since when the velocity at which the mixture leaves the ports too greatly exceeds the velocity of flame propagation, we have the blowing away of the flame. It follows that the working range of the burner lies between these limits, both of which depend upon the velocity of flame propagation. This velocity depends upon a number of things, among which are the composition of the gas, the air-gas ratio, and the temperature of the mixture. It is high for water and gas and low for natural gas; consequently, we must use high velocity of mixture issuing from the ports for water gas and low values for natural gas; this means the proper port area per cubic foot of gas burned or per square inch of mixing tube area is much smaller for water gas than for natural gas, and this explains why a burner designed for natural gas will flash back if used on artificial gas.

The velocities of flame propagation are not generally known with accuracy for any complete set of conditions, but the practical limits of design for gases of known composition under known conditions may be ascertained by experiment. This may be illustrated by reproducing a set of curves (figure 4) from the report of the Bureau of Standards, already referred to which shows the limit of operation of three burners under certain conditions with varying air-gas ratios. From this we see that with a 1¼-in. pipe burner having 1.35 sq. in. total port area, the limiting velocity for an air-gas ratio of 3 are 3.5 and 15 ft. per second; below the former, we have flash-back and above the latter, the flames blow away. Also that when the air-gas ratio falls to a little more than 1.5 we reach the yellow tip limit of our flame. It also shows that for this particular burner, we cannot operate at a ratio higher than 4 and that as we approach this ratio the working limits are very close together.

Since these limits will be quite different for different kinds of gas, we must either design for a particular kind and use the burner on that kind only, or select a compromise design. When the difference in the gas characteristics is great as between water gas and natural gas, we should pursue the former course, but we can obtain a compromise value that will do very well for both coal and water gas, and mixtures of the two.

Having arrived at the proper total port area for a given burner, the next step will be to decide on the proper cross-sectional area of space allowed within the burner. If this area is too small, the frictional resistance will be so great that the injecting power of the burner will be cut down and it will be unable to function properly. If, on the other hand, this space is too large the reservoir within the burner will be so great that it will take it a long time to fill with the air-gas mixture which will lead to flash-back on lighting and also the energy of the gas jet will be dissipated by eddy currents within the burner. We believe that the best rule will be to determine this cross-sectional area from the port area, or it may be derived directly from the amount of gas that the burner must handle. In the case of burners built from standard wrought-iron pipe, we may allow one square inch of cross-sectional area for each sixty cubic feet of gas to be handled per hours; for carbureted water gas. and for coal and coke oven gas.

No general rule can be laid down for burners of irregular shape such as star burners. In the case of ring burners, we can consider the burner to be fed from the mixing tube from two directions and to determine the cross-sectional area of the ring part of the burner, we will allow 120 cu. ft. of gas to each square inch of cross-sectional area.

The conditions governing the spacing of ports are determined by two major considerations. First, the ports must be far enough apart to allow free access for the necessary secondary air around each flame, while at the same time they must be so close that the flame will easily run from port to port when the burner is lighted. The smaller the ports, the greater the frictional resistance to the flow of the air-gas mixture and the greater the danger of closing due to rust and corrosion, but the less chance of flash-back. The same condition applies to the thickness of the material through which the ports are drilled. As a general rule, we may use smaller ports in a cast-iron burner than in a wrought-iron burner as the tendency of the burner to be closed up by rust or corrosion is less in the former than in the latter.

Burner ports are practically always drilled holes or slots either of these will give good results provided the spacing, area and arrangement are correct. The following general rules may be used in the design of burners for general use.

For total port area allow:

	Per 1,000 B.t.u. Per Hr.
For carbureted water gas	0.025 sq. in.
For coal and coke oven gas.....	0.030 sq. in.
For natural gas	0.080 sq. in.

In general, allow a space not less than twice the port diameter between adjacent ports.

For artificial gas, ports in wrought-iron pipes should not be less than one-eighth-inch diameter, except for very small burners.

For cast-iron burners, ports should never be less

than one-sixteenth inch, except for very small burners.

Ports should not be more than three-sixteenths inch in diameter, except in special cases, and never more than one-fourth inch. When ports are smaller than one-eighth inch they should be spaced three to the inch. One-eighth-inch ports may be two or three to the inch. Ports larger than one-eighth inch should be spaced so that the distance between ports may be about twice the port diameter.

In this respect, as in many others which we meet in the design of burners, the conditions under which the burner is to be used will affect its design: for instance, if we know that the burner is to be placed close to the object to be heated, we may count upon this baffling effect to aid the flames running from port to port. We should, however, always be sure that our burner will light completely, especially if it is to be under automatic control. The consequences of a burner that fails to light for its whole length may be very serious.

The subject of burner ports naturally introduces the question as to whether the use of a gauze or screen is justified as a means of preventing flash-back, and our answer will be an emphatic no, if the burner is properly designed there will be no need of a gauze. The placing of gauze in a burner is an invitation to trouble, and an admission of poor design.

The practice often followed in cast-iron burners of raising the metal around the port has certain slight advantages. By making a longer channel, it tends to keep the burner cooler and prevents flash-back. It also promotes the flow of secondary air around the burner. However, a perfectly satisfactory burner can be designed without resorting to this device.

Another thing that must be considered while choosing our port area is that we must secure reasonable uniformity of flame height. Take the case of a pipe burner: All the mixture must pass the first port. Its velocity is greatest at this point. At the last port, there is no velocity. At the first port, the mixture has both velocity and static pressures, but at the last port it has only static pressure; therefore, the static pressure is a maximum at the last port, since the volume of the mixture issuing from any port depends upon the static pressure. It follows that if we have a large difference in static pressure in different parts of the burner, we will have unequal flame heights. This condition will exist when the port area is large in comparison to the cross-sectional area of the burner.

It is also evident that this same condition tends to promote flash-back with gases having a high velocity of flame propagation. To meet general conditions, we may say that the ratio of port area to cross-sectional area of burner should be not more than 0.8 for carbureted water gas, and not more than 0.95 for coal and coke oven gas.

The variety of shapes in which burners may be made is so great that it is impossible to attempt any discussion of their detailed design, but if the foregoing principles which have been so briefly alluded to be kept in mind, satisfactory burners may be produced for all cases.

A great many of our applications can be well served by pipe burners made from standard wrought-iron pipe, either straight or bent to suit the particular application for which they are designed. The following table gives data for the design of such burners for general use. This data may be used for burners without injector tubes, and will give air-gas ratios of about 2.5. If injector tubes are used, the capacities may be increased 20 to 25 per cent, or with the capacities given, the air-gas ratio may be increased to secure a very sharp and intense flame.

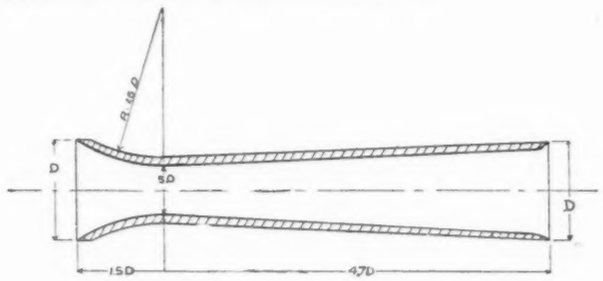


Fig 3-Injector Tube Correct Shape

Capacity is based on one cubic foot of gas per hour for each 0.0165 sq. in. of actual cross-sectional area, or 60 cu. ft. per hour per square inch of cross-sectional area. Burner-port area is 0.8 of cross-sectional area for water gas and 0.95 for coal or coke oven gas.

For natural gas, take capacity at 60 per cent of above figures and make total port area two times cross-sectional area.

Where burners have an elbow or other short-radius turn or any form of baffle in burner, decrease capacity by 15 per cent.

Data for the Design of Burners from Standard Wrought-Iron Pipe

Diameter of Pipe		Actual Internal Cross-Sectional	Maximum Capacity at Various Pressures				Port Area—Sq. In.	
Nominal	Actual	Area—Sq. In.	1 In.	2 In.	3 In.	4 In.	Water Gas	Coal Gas
¼ in.	0.364 in.	0.140 sq. in.	5.5	8	9.5	11	0.11	0.13
½	0.622	0.304	1.2	18	22.0	25	0.24	0.29
¾	0.824	0.533	22.0	32	39.0	45	0.43	0.50
1	1.050	0.860	36.0	52	64.0	73	0.68	0.82
1¼	1.380	1.496	63.0	90	110.0	125	1.20	1.40
1½	1.610	2.036	88.0	125	156.0	175	1.60	1.90
2	2.060	3.356	140.0	200	245.0	280	2.70	3.20
2½	2.470	4.780	205.0	290	355.0	410	3.80	4.50
3	3.060	7.380	320.0	450	550.0	640	5.90	7.00
4	4.030	12.560	530.0	760	930.0	1,070	10.00	12.00

The Mixer and the Air Shutter

That part of the burner usually spoken of as the mixer is considered last as it is a part that holds together and unites other parts. Very little mixing of air and gas actually takes place in the mixer; this is carried out in the mixing tube. The function of the mixer is to connect with the burner cock, and to carry and hold in place the orifice and mixing tube. The importance of this function cannot be too greatly emphasized for correct and true alignment of orifice and mixing tube are vital to the efficient operation of the burner. The gas jet should be projected from the orifice towards the center of the tube; if the alignment is not true and it tends to one side, its entraining powers are greatly reduced and a poor flame and flash-back trouble may result. We must see that the burner cock, mixer, orifice and mixing tube have a common center line if we want a good burner.

The openings which admit primary air to the burner should be large enough to admit all the air that the burner is designed to handle with practically no loss due to friction. A general rule would be to make these openings equal to at least one-half of the cross-sectional area of the expanded mixing tube. This opening should be adjustable by means of a moveable air shutter which can be quickly and accurately adjusted, and which when once adjusted, will remain securely in place. Our experience is that vertical openings in a vertical shutter give the best results, because there is less opportunity for them to become clogged by dirt, dust or other foreign matter.

We often see mixers with air shutters which are arranged to move with the burner cock and open or close as it does, and the question presents itself, Is anything gained by this device? The true answer is that nothing is gained. We have seen that the air entraining power of the gas jet is proportional to its momentum. As the cock closes the pressure behind the orifice is reduced and the velocity and mass of the gas in the jet will be both reduced, but the entraining power of the jet is proportional to the product of the mass by the velocity, hence it follows that the entrained air will decrease more rapidly than the volume of gas going to the burner; closing the air shutter is entirely unnecessary and cannot possibly help to maintain a constant proportion of primary air. It is possible that such a mixer may help to prevent flash-back by retarding the flow of air as the cock is opened, but with a properly designed burner, this would be unnecessary; under either consideration, such a mixer is a useless complication and poor practice.

General Consideration and Illustration of Design

It should always be remembered that the figures given in the preceding tables and rules, represent in many cases compromise values such as should be used in building burners for general use. If, however, we know exactly the kind of gas and the conditions of use, we can modify our design to obtain the best results for the particular case. The maximum capacities given in the preceding table are not the maximum capacities for any condition, but the maximum capacities that can be obtained with a general design which will serve for a wide range of gas composition, pressure and other conditions and still preserve the other good characteristics of the burner.

If we know the conditions under which the burner is to be used, we may modify our design. Thus, if we were building a burner for space heating or some similar application where high flame temperature was of no particular advantage and where there was plenty of room for a large flame, we would not care for a high air-gas ratio and there would be no need for, or advantage in, using injector cones, and we could use higher capacity values than those of the table. This would simply mean a low air-gas ratio and a soft flame.

On the other hand, if we were building a burner to go under a pot or tank for fairly high temperature work, we would want to obtain the sharpest and most intense flame possible, as this would mean the best efficiency. To do this, we must have a high air-gas ratio and we would use capacities lower than those given in the table, and use injector cones in the mixing tube; furthermore, if we knew that the burner would never be put under automatic control and would never be turned very low, we could approach nearer to the flash-back point by using a high ratio of port area to cross-sectional area of burner, knowing that under manual control flash-back is not so serious as where the control is automatic.

Let me illustrate the use of the tables and the design of a pipe burner by a practical case. Suppose it is necessary to heat a rectangular flat-bottomed tank containing water or some other liquid, by means of two burners placed beneath it. Let the length of the tank be 36 in. and let the gas available be carbureted water gas of 500 B.t.u. per cubic foot, and the minimum pressure two pounds.

Let us suppose that we have calculated the maximum heat requirements at 75,000 B.t.u. per hour and the efficiency of our application at 50 per cent; then it will be necessary to burn 300 cu. ft. of gas per hour, or 150 cu. ft. per burner. Referring to our table of pipe burners, we see that the 1½-in. pipe has a rated capacity of 125 cu. ft. and that we can increase this to 150 by using injector cone mixing tubes, but since we are going to burn under a flat-bottomed vessel, we want as sharp a flame as possible and it seems better to use a two-inch pipe with an injector cone mixing tube and get the highest air-gas ratio and the sharpest flame possible. We may take our port area at 2.7 sq. in. as given in the table, or we may calculate it by allowing 0.025 sq. in. per 1,000 B.t.u.; this will give an area of only 1.87 sq. in. for automatic operation. This would probably be a good value to use, but assuming manual control in this case, we choose the value of 2.7 sq. in. This with an air-gas ratio of three will give a maximum velocity to the mixture issuing from the ports of 8.9 ft. per second. Referring to our curves, showing the low limiting values of velocities for water gas, we see that this is well situated between the limits and we decide to use it.

The length of the burner proper, that is that part containing the ports, is in this case determined by the length of the tank and is thirty-six inches, and since the first port should be six times the diameter of the mixing tube from the orifice, the length of the entire burner and mixer will be $36 + 12 = 48$ in.

The mixing tube may be provided with an injector cone by designing and making up a tube according to the dimensions given in the section on the mixing tubes.

The next thing is to decide on the size of ports and their spacing. Suppose we decide to try ⅛-in. ports and ½-in. spacing between centers. Since the area of a ⅛-in. circle is 0.0123 sq. in., the number of ports will be 2.7 ÷ 0.0123 = 219, but to use 219 ports with ½-in. spacing we would have to use three rows. Since the burner is 36 in. long, three rows would contain 36 × 3 × 2 = 216, which with three jumper ports between rows would be just right. But three rows would not be desirable, as in the application we are considering there might not be free access of secondary air to the inner row, and it is also evident that we can afford to make our ports larger than ⅛ in. on this burner. Two rows and three jumper ports will give us, with ½-in. spacing, 36 × 2 × 2 + 3 = 147, and the area of each port would be 2.7 ÷ 147 = 0.0184 sq. in. Referring to our table of areas, we select the next smaller drill, which is No. 24. We decide to lo-

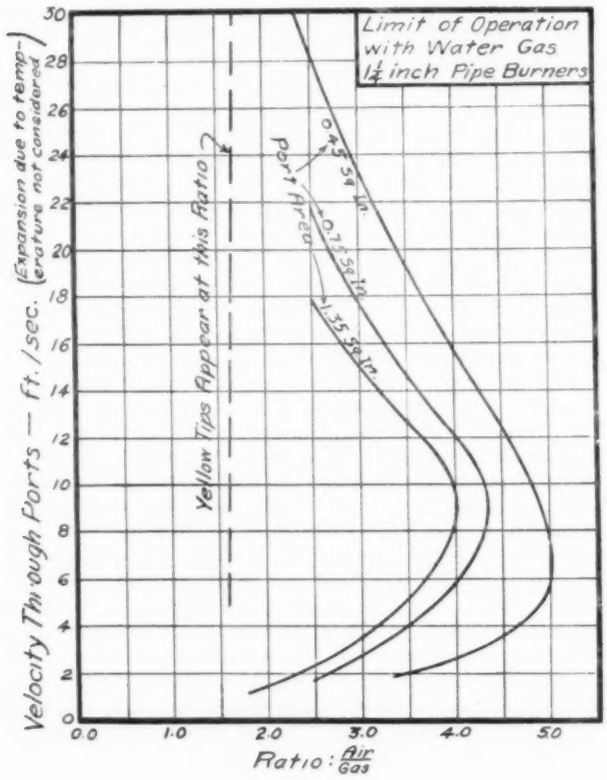

Limit of Operation with Water Gas 1¼ inch Pipe Burners
Velocity Through Ports — Ft./Sec. (Expansion due to temperature not considered)
Yellow Tips Appear at this Ratio
Port Area
0.45 Sq. In.
0.75 Sq. In.
1.35 Sq. In.
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
0.0 1.0 2.0 3.0 4.0 5.0
Ratio: Air/Gas

Fig. 4

cate our rows 45 deg. from the vertical axis of the burner and the ports in the two rows will, of course, be staggered; this completes the design of the burner. We must see that it is fitted with a proper mixer and air shutter and a cock of adequate size and it is finished.

Probably the quickest and best way to lay out such a burner for drilling is to take a piece of paper as long as the burner and of a width equal to the outside circumference of the burner. The location of the centers of the ports are marked on the paper on a drawing board. The paper can then be wrapped around the pipe to be drilled, being held by several rubber bands, and the ports are center punched by the marks on the paper.

Some Elementary Principles of Application

Having designed our burner along proper lines, it behooves us to see that we apply it properly. It would be the height of folly to go to the trouble of designing a burner for the highest efficiency and then place it so carelessly that we lose the benefit of the very qualities we have been to such pains to secure in the burner, and yet, this may easily happen, as for instance, we have just illustrated the design of a burner to secure high flame temperature and concentration. If we place this burner too far from the surface to be heated, we may lose more than we gained and would have been better off with a stock burner with a long flame.

The question of head room is probably the most important single consideration affecting the efficiency of application of burners. Where the burner is so far away from the thing to be heated that it loses flame contact, the efficiency declines very rapidly, while if it is too close, the flame smothers and poor combustion results. At the same time, it is a subject on which it is very hard to lay down definite rules. In general, we can safely say that the tip of the flame should always maintain contact with the thing to be heated, but the inner cone of the flame should never be allowed to approach contact. We may say as a general rule, that the head room should be twice the height of the inner cone.

Another common source of heat loss in application is over ventilation. We want free access of secondary air to the burner where it is needed, but beyond this we want as little air drawn in as possible. If our appliance is vented, we can regulate this by a damper or baffle in the vent, but in how many of the installations in general use has this been done? The Orsat will tell a tale of great quantities of excess air if applied to most of them. It is a pity that this valuable instrument is so seldom used to find out how much excess air we are circulating with our heat.

Other factors will affect our application efficiency, but like those just mentioned, they are so elementary and so evident that it seems unnecessary to discuss them. They may be summed up by saying Study your application closely and see that the heat developed at the burner goes where you want it; watch the leaks and losses by which it escapes.

The object of this article has been to point out some of the principles affecting the design of atmospheric burners. It is by no means a complete discussion of the subject, but if it may in any way arouse or stimulate interest and lead others to more extended and complete handling of the subject, it will have entirely served its purpose.

Filtration and Pressure Plant

Buffalo, N. Y.—A gas filtration and pressure plant is to be erected in South Buffalo near the Donner Union Coke plant, by the new Niagara Gas Corporation, which recently took over the gas plant and system of William J. Judge. It is understood that about $400,000 will be spent on the project.

The plant will be used to purify and compress the manufactured gas. It will be in operation about Dec. 1.

At the office of Mr. Judge, it was said that the mixing of natural and manufactured gas was not contemplated at present. The office of the new company will be at the Church Street after Oct. 31.

Vital Factors Affecting Central Station Industrial Gas Business

(*Continued from page 367.*)

Our condition to-day is very much similar to that of the electric central station some years back. During the past five years, especially because of the enormously increased production due to the war and after war period, we were able to obtain a large amount of industrial business. Many of these customers, especially the largest ones, accepted our fuel in spite of the high rates because no other adequate fuel was available. This business yielded the gas companies a handsome profit and helped to minimize the losses sustained in supplying domestic customers.

To-day, with all industry trying to cut production costs, we find that we are rapidly losing our best and most profitable customers. In visiting the large industrial centers I see manufacturer after manufacturer planning to discard central-station gas in favor of fuel of lower cost, such as fuel oil, oil gas, producer gas, water gas, or combination coal and water gas.

To remedy this condition, we must follow the example of the electric industry. We must adopt a scale of rates which will charge the domestic customer in proportion to his expense of the service and the industrial consumer likewise. Our present system whereby we undercharge the domestic customer and overcharge the industrial user is absolutely discriminatory, unreasonable and above all suicidal.

To talk about and suggest proper industrial rates is relatively an easy matter. To accomplish this, however, represents many serious difficulties. Many of our gas managers, in order to maintain and improve their industrial business, have attempted to establish industrial rates which would make it possible for central-station gas to compete with other fuels. When the gasman attempted to do this he found out that he would lose an enormous amount of revenue. This he could not afford as his present revenues were even inadequate to provide a fair return on his plant investment.

Another means, however, was possible. The gas company could, perhaps, lower industrial rates, and at the same time maintain its revenue by increasing domestic rates. To do this would mean to go before the Public Utility Commission and fight for an increase in domestic rates with a consequent lowering of industrial rates.

This would represent an extremely radical step, and has been generally considered by the gas manager as a move which would be too big and difficult to undertake. Thus while many of our managers realized the wisdom of lower industrial rates, they found their hands tied and could do nothing.

Industrial Business at Stake

While the difficulties to be overcome are great, we must remember that the future of our industrial business is at stake. The immediate establishment of proper industrial rates is vital to our business. We cannot stand still. We must either move forward or relinquish our future. Our backs are to the wall and we must fight not only for a big successful future, but also for our very existence. There must be a solution.

The establishment of proper industrial rates means an entirely new policy and attitude on the part of the company and those concerned. The gas company should sell the industrial customer gas at cost plus a fair return on the plant investment. When this is done the company will be better able to compete with other industrial fuels. In order to do this and at the same time maintain a fair return on its total capital investment, the company will have to go before the commission and ask for higher domestic rates. Doing this is indeed a radical departure and such a move would undoubtedly meet with delay, complication and uncertain success, when undertaken by a single company.

This problem, however, does not concern only one company. It belongs to the entire industry, and should be solved by the combined efforts of all gas organizations through the gas fraternity. This problem can be most successfully solved with the aid of our national organization, the American Gas Association. The establishment of proper and equitable industrial and domestic rates should be accepted as an issue or policy of the entire industry and sold to the various State commissions by our national association. When our State commissions have accepted this policy as a fair and equitable system of rates, it will be an easy matter for each and every company to establish its rates in accordance with the local conditions.

Such a policy is not unreasonable. In supplying the domestic customer the gas company only performs a part of its function. In supplying the industries of a community with a fuel which will facilitate production and lower costs, the gas company is serving not only the industry but also the community and all its people. By supplying not only the domestic needs, but also the industrial requirements, the central station can best serve the people, and thereby be of maximum utility to the community. This goal can only be reached when each and every gas company is allowed to distribute its charges for gas supply equitably to the different consumers, and by this method to establish the proper industrial and domestic rates which will make it possible to serve the domestic customer with all fairness and at the same time be of maximum service to the industries in proximity to our central stations.

Domestic Increase Only Temporary

In working out this policy it would only be necessary to increase domestic rates temporarily. Lowering industrial rates to the point where our companies can secure large industrial business will ultimately result in lower rates for domestic customers, because the company with a large and diversified lead will be able to make and distribute gas more cheaply to its domestic customers than if it had to rely on a purely domestic load. While our plans, therefore, may result in temporary hardships upon the domestic consumer it will ultimately be to their interest because of the fact that the company will be in a position to supply also the domestic load at lower rates than at the present time. The installation of proper industrial rates will eventually result in cheaper gas for both the industrial and domestic consumers.

The thought that the gas company should not only try to serve the domestic consumer, but should also

endeavor to supply industries at the most reasonable industrial rate, has rather vividly been brought to light by several manufacturers asking for proper industrial rates which will make it possible for them to be able to use our product.

Better Efficiency in Gas Utilization

The subject of efficient fuel utilization is only in its infancy. The economies that can be realized along these lines are appreciated to only a very limited extent. Gaseous fuel has the inherent qualities so that it is possible to utilize it with greater efficiency than any of our other fuels, excluding electricity.

All gas companies will be well repaid by giving more time and study to the efficient utilization of industrial gas. The development of better industrial appliances can and will be accomplished. Appliances which allow for the efficient combustion of our fuel and guard against enormous heat radiation and conduction losses will greatly aid in giving the manufacturer better service with a resultant lower fuel cost.

There is one phase of this subject that merits special consideration. The use of recuperators and regenerators is one of the most practical and effective means of saving fuel and lowering the fuel costs per unit of production. In industrial furnaces the flue gases leaving the furnace contain from 25 to 75 per cent of the heat of combustion depending upon their temperature. By using recuperators and regenerators we can save from 30 to 75 per cent of this heat and by this means we can thereby increase the efficiency of our heating operations from 15 to 200 per cent, depending upon the temperature of the furnace, its former efficiency, the efficiency of our heat interchangers and many other conditions.

Regenerators are most favorable for very large furnaces, where the cost and operation of the reversing valves are not important factors, such as glass furnaces, open-hearth furnaces, etc. Regenerators allow for the maximum recovery of the heat of the flue gases, but are not very applicable to the average small furnace or appliance because of the necessity of operating the valves intermittently and of having to contend with a varying temperature in the preheated air.

Recuperators, however, need no attention, allow for the use of gas and air under pressure, and require far less space. This committee believes that practically every appliance should contain some form of heat recuperator. With present developments in the manufacture of high temperature resisting metals of reasonable cost, the compact metallic recuperator is now a commercial success. Practically all of our industrial furnaces and appliances can be equipped with metallic recuperators that will allow us to preheat our air and gas as high as 1,200 deg. Fahr. This recuperator will not readily corrode and will last for long periods of time sufficient to warrant their adoption. The economies effected by the use of a metallic recuperator are usually sufficient to pay for the recuperator in a period of six months. This means 200 per cent profit on this investment.

By means of recuperators and regenerators wonderful economies have been obtained. In one case a high temperature drop forge furnace, operating at an efficiency of 7 per cent, was replaced by a furnace containing regenerators and the efficiency of the furnace rose to 25 per cent. The actual efficiency of this operation was therefore increased three and a half times. In this installation the economies effected, due to better design, better heat insulation and the use of regenerators were so great that the company was able to displace fuel oil by city gas. In several cases the use of metallic recuperators in heat treating and annealing furnaces have produced such economies that they have made possible the use of city gas in competition with other fuels. The use of a metallic recuperator in connection with a recently developed one-ton brass melting furnace has resulted in a fuel consumption of only two and a half feet of city gas per pound of brass melted, together with high furnace capacity and low metal losses. A furnace of this kind will result in a 50 per cent saving of fuel in comparison with ordinary or standard practice.

Some of our companies that have been pioneers in this work have been able to greatly expand their industrial business simply because they could utilize gas with far greater efficiency than the manufacturers could obtain by other fuels. The following comparative data are results of actual practical operations and represent the amounts of other fuels that can be displaced by central-station gas by any company that will give this subject the proper attention.

One million B.t.u. of city gas will displace any one of the following:

1,050,000 to 1,500,000 B.t.u. of natural gas.

Eight to fourteen gallons of fuel oil—1,100,000 to 2,000,000 B.t.u.

1,500,000 to 2,000,000 B.t.u. of coal fired in the producer.

1,500,000 to 4,000,000 B.t.u. of coal or coke used in the solid form.

The above comparisons show that even when our cost of city gas is 50, 100 or 200 per cent higher than the cost of other fuels on the basis of B.t.u., we shall nevertheless be able to sell central-station gas in a competitive market and perform many heating operations at a lower cost per unit of finished product than can be effected with other fuels.

The gasman knows that better and more efficient application of our fuel has greatly helped our industrial business during the past few years. The progress made, however, has been relatively small and leaves many of the problems unsolved. The advantages to be gained are so vital to the future of our business that we should immediately adopt means to obtain the desired results with all possible speed, in the most complete form, and in the most effective manner.

This problem, like that of rates, does not belong to the individual company. This matter concerns the future of the entire industry. The industrial fuel sales committee believes this subject can be most effectively worked out by the combined efforts of all companies.

We offer as a suggestion the following possible manner of co-ordinating and advancing our knowledge of the efficient utilization of city gas for industrial purposes. This matter can be satisfactorily handled by a committee appointed by the American Gas Association. The work to be undertaken would necessarily be divided into two sections: First, the

study of the present appliances, furnaces and heat applications; second, efforts to perfect better, more economical, and more efficient appliances and improved methods of fuel utilization.

Of course, this idea is not entirely a new one. The first part of the suggestion which deals with the information bearing on the present utilization equipment has been carried out for many years by our association and has greatly aided in increasing our industrial fuel sales. We urge, however, that this work be somewhat extended and above all kept up to date. The most valuable portion of the service is for all industrial fuel departments to have complete information regarding the latest and most efficient developments. The advantages to be gained by this service are of such importance in facilitating the development of our business that we can well afford to give this matter more time, thought and study than we have in the past.

Perhaps the work of the committee would be most valuable if all the data were compiled in the form of a digest report, a copy of which was in possession of each member company. This report would be annually revised. This service would offer, in the most concise form possible, the essential characteristics of all heating processes, the best appliances available, and the advantages and the efficiencies gained in the various processes with the different kinds of fuels. Our data will tell us the best appliance for any particular operation and what the comparative efficiencies are when using city gas with any other fuel in the same type or another type of furnace. With such a compilation of up-to-date facts the industrial fuel man is in a position to realize his opportunities to the fullest possible extent because he knows just what business to go after and just what economies he can effect by the use of the most improved equipment available at that time.

Research Laboratory Necessary

A thorough knowledge of the present appliances and methods of utilization of our fuel are not sufficient if we are to progress. The efficiencies and economies of our present appliances can and will be greatly increased. In order to accomplish this, the above named committee would have charge of a research laboratory supported by the member companies of our association. This research organization would undertake to realize upon the inherent advantages of central-station gas over other fuels and work toward the development of appliances and furnaces which would make it possible to use city gas with the greatest practical efficiency and economy. By this method we would soon be able to apply city gas with such efficiency that we would be able to greatly expand our industrial business and compete with other fuels which cost two to three times less on a B.t.u. basis.

While the accomplishment of this work would appear to be the function of the appliance manufacturer, we realize that if we are to make the proper and necessary amount of progress we must take a hand in the matter. We realize that the appliance manufacturer has been extremely handicapped because of the fact that in many cases the expense of pioneering the development of new appliances, seemed not to be justified by the advantages to be gained. We can therefore readily see that if we wish this matter to be developed with the greatest possible speed, we must aid the various appliance manufacturers by some form of subsidy or else undertake the solution of these problems by co-ordinating our own experience, knowledge and efforts. The latter method appears to us to be by for the most practical one, and for this reason we advocate the establishment of a research laboratory.

The true realization of this plan can only be really successful when undertaken by men who can devote their entire time to this work. The data to be constantly compiled and the research to be undertaken cannot be effectively accomplished by the agency of more or less transient committees. The members of our association committees have their regular work, which comes ahead of committee work. To accomplish real valuable results and carry out our plans in the most complete and thorough manner, it will undoubtedly be advisable for the association to adopt some means whereby this work will be undertaken by men who can give their entire time to the compilation of data on appliances and the working out of our research problems. Such a scheme is now being successfully employed in solving the problems of the malleable iron industry.

Greater Economy and Efficiency in Manufacture

It is true that such a research laboratory was suggested a few years ago, but because of the unsatisfactory financial situation at that time the suggestion did not meet with any real success. However, this committee believes that the suggestion regarding the research laboratory for the industry should again be considered and acted upon. There can be little doubt in the mind of any gasman that the work of a committee towards standardization of present utilization equipment and methods combined with the research organization to develop better appliances and furnaces will be of tremendous service in accelerating the enhancement and development of our industry.

With success in the development of proper industrial rates and more efficient appliances, we shall be able to lower the cost of gas to the consumers to such an extent that we shall not only be able to retain our present industrial customers but shall also be able by this means to increase our sales in the immediate future. With all these accomplishments, however, we shall find that our potentialities have been realized to only a very small extent. Perhaps the biggest factor in our future development lies in another direction.

Proper rates and better appliances mean immediate relief and expansion. The element which is most important in the ultimate maximum development of industrial business is better, more efficient and more economic methods of gas manufacture. Such methods will use the poorer grades of our enormous coal resources and with small initial expense will transform these fuels into gaseous heat units.

The present status of more efficient gas manufacture is most encouraging. Several processes are being developed both in this country and abroad which indicate the recovery of large amounts of tar and ammonia and in the neighborhood of 20,000,000 B.t.u. of a high quality gas per ton of coal. Most of these, it seems are a combination of low-temperature carbonization of coal with the manufacture of water gas from the resultant coke. The gas obtained is a mix-

ture of coal gas and water gas and varies in B.t.u. value from 300 to 400 B.t.u.

Developments of this kind should be of the greatest interest to all gasmen. It really seems as if we can now look with certainty to the realization of our hopes for the future of our business. We can now look forward to the practical development within the decade of a process of gas manufacture that will yield from a ton of bituminous coal, five to fifteen pounds of ammonia, fifteen to twenty gallons of coal tar, from 18,000,000 to 22,000,000 B.t.u. of gas. Such a system will obviously be highly efficient and will produce B.t.u. at such low cost that our central-station gas will be able to enter all competitive fuel markets.

With the development of proper rates, better appliances and more efficient manufacturing methods, the possibilities for industrial gas become immense. Not only does central-station gas become a competitive fuel for each and every industrial heating operation, but the idea also becomes practical of using this gas for house-heating purposes.

At this point the committee wishes to sound a note of warning. All our success, expansion and progress is engulfed and held in the balance by a powerful agent—legislation Developments of more efficient gas manufacturing methods are valueless unless we can get rid of the present ridiculous standards regulating gas supply. There is absolutely no justification or even sanity in legislation which continues to force our utilities to supply a gas of certain B.t.u. value which is more expensive to manufacture and of no greater value than a gas which can be readily manufactured at a lower cost.

Of course, we are making progress along these lines. Some of our municipalities have been able to get down the calorific value of the gas from 600 to 425 B.t.u. This progress, however, rather than representing the majority of our companies represents the attitude and enlightenment of only a very few of our State commissions. This problem, like the rest, can only be successfully met by all our companies organizing themselves into one body and taking the problem as a national issue. The present gas standards are absolutely unnecessary, antiquated, and should be abolished. There is no reason why any company should be hampered by any regulation regarding the B.t.u. value of the gas within certain limits. If we really wish to learn a lesson and realize what can be done along these lines, we need only to look into the experience and happenings in England.

The British utilities during and after the war were pressed to such an extent by economic conditions that they were absolutely forced to demand a change of legislation affecting the gas supply. Their efforts eventually were realized by the passage of the British gas regulation act, which removed the antiquated standards, and by this means are affording each and every company the necessary amount of freedom to manufacture and supply gaseous fuel in the most economical manner. The B.t.u. value of gas in England is slowly decreasing. At the present time we find several towns that are using a 400-B.t.u. gas both for domestic and industrial purposes with entire satisfaction to all parties concerned. Greater economies and greater efficiencies in England are now only dependent upon the establishment of more economical and more efficient methods of manufacture. Such work is making very rapid progress, due to the fact of the encouragement received by the passage of the British gas regulation act with the consequent elimination of all unnecessary and hampering legislation.

It may be well to mention the point of view finally adopted in England in reference to the carbon monoxide content of the gas. With the passage of the British gas regulation act, a committee was appointed by the Board of Trade to look into the legislation to restrict the percentage of carbon monoxide in the gas. After many months of investigation the committee reports "That it is unnecessary or undesirable to prescribe any limitation on the proportion of carbon monoxide which may be supplied with gas used for domestic purposes." The gas, however, must have the distinctive pungent smell of coal gas.

It is interesting to note that the findings of this committee were largely influenced by the information received from experience in this country. The committee communicated with the Surgeon General of the United States Bureau of Public Health Service in regard to the poisonous effects of the high carbon-monoxide content of the carbureted water gas supplied in this country. The evidence submitted, which showed that high carbon-monoxide content was not detrimental as long as the gas was properly odorized, greatly aided the committee in arriving at the above conclusion.

A committee was also appointed by the Board of Trade to look into the advisability of restricting the percentage of inerts in the gas. This committee, after thorough investigation, has come to the conclusion that it has not been established in evidence that the restriction of incombustibles is necessary or desirable at the present time. The committee, however, suggests that the matter again be brought up three years hence at which time the country in general will have had sufficient experience in the use of different grades of gas in order to more intelligently discuss this problem. All these matters put the British gas utilities in a position where they are able to carry on and develop their business along the most economical lines and in a manner most satisfactory to all parties concerned. The general result will be better service at lower cost.

With the combined experience of England and ourselves in regard to these matters we should not hesitate to immediately make plans so that we can perform our proper functions in the community. By combining our efforts, and fighting for ou rrights as one large unit representing the entire gas fraternity, we can hope to establish the proper legislation in the shortest amount of time. Not only should we be ready with the proper legislation to make possible the commercialization of cheaper methods of making gas, but we should free ourselves with the greatest possible speed from the present restrictive measures which tend to demoralize and retard progress along the lines of developing more efficient and more economical methods of gas production.

Let us not wait until we are compelled by endangering economic pressure to unleash our present legislation but let us profit by England's experience and remove the shackles which have kept our proper development and prosperity in bondage. Let us enact legislation that will allow us to give all customers the best service at the lowest cost.

The Future

Progress in the past in connection with industrial fuel sales has necessarily been slow, due to the many existing unfavorable conditions. In the first place, it is only in the past few years that the gasman, generally speaking, has become aware of the wonderful possibilities offered for industrial gas. Even with this knowledge at our command, we found ourselves limited in many different directions. We were tied in by legislation which forced us to make an expensive gas and prevented us from making a good industrial fuel with the maximum of economy. Then we reached a gulf when we tried to establish proper industrial rates; on one side the necessity for increased domestic rates and the commission was against us; on the other, the fact that by decreasing industrial rates we would so diminish our revenues that we would be sent to the poorhouse. Then again the general financial situation was such that we were not able to obtain funds for the proper necessary extensions in order to take care of more industrial business. All these factors worked together to retard our expansion and the proper realization of our true functions.

At this point it might be well for the committee to again emphasize what the real ambition of the gas company should be. We must always keep before us the ultimate function of the gas company to supply all of the heating requirements of its municipalities. Our goal should be to supply a gas economical in manufacture and economical in utilization, at the lowest practical price compatible with a reasonable return on the money invested. To our mind there is no justification for individual isolated gas plants which are operated under neither scientific nor economic conditions. The central station is not only under obligation to supply domestic requirements but also the industrial demands of the community. If a manufacturer desires a gaseous fuel, it is the duty of your company to supply his demand. The present limitations of our business are no justification for not meeting the demands for our product.

The industral fuel sales committee believes that we can make the most progress by unifying our efforts. Our problems do not belong to the individual, to this or that company, but concern the entire industry. Our success is dependent upon the solution of many problems—proper rates, better appliances and more economic manufacture, together with the enactment of proper legislation and the removal of ridiculous and hampering restrictions. These problems are entirely too much to be overcome by the efforts of any single company. However, when we combine all our efforts, function by means of the American Gas Association and stand as one man with a definite policy and a definite viewpoint, our difficulties and problems are readily solvable. As one large unit our policies and issues can be properly presented to the proper Federal and State authorities and by this means we can hope for the proper unbiased investigation which can only lead to a better understanding between ourselves, the commissions and the people. By unification of our efforts, our problems shrink, become a tangible and certain of successful solution. By this means only can we hope to bring before the American people the proper functions and real service values of our public utilities.

Our problems have been with us for many years. During the war and after the war period we had all we could do to hold things together. To-day we stand upon the threshold of a new career. The financial condition of our utilities is better than it has been for years and this improvement is slowly but surely increasing. The attitude between the companies and the commissions together with the public has never been better. The point of view of the different parties concerned is gradually working towards one goal with the consequent proper understanding by all. The needs of the manufacturer for a proper gaseous fuel, such as central-station gas, have never been in greater demand. The experience and progress during the past few years in the manufacture and utilization of a gaseous fuel lead us to believe that we will soon solve the problem of an economic and adequate industrial gaseous fuel. All these conditions mesh themselves together to put us at the top of the hill, and all we have to do is to go over the top. All we have to do is unify our efforts to solve the problems, and win the game. But we must act, and the time to act is now.

The future for both the industrial gas business and the gas companies is very bright indeed. By adopting proper industrial gas rates we can increase our business to a large extent. By developing better appliances and increasing the efficiency and utilization of our gaseous fuel, we shall be able to further increase our industrial sales. Finally, by these two methods together with an economic and efficient method for the complete gasification of coal, we shall be able to realize all of our potential fuel business. We can now, with all certainty, look upon the time when the gas business will come into its own, be the biggest of our public service institutions and take care of the fuel requirements in every city, town and municipality.

There is more than a billion dollars' worth of annual business awaiting the gasman. This committee suggests that we take advantage of the knowledge and experience of past developments, that we seize the present opportunity, and by unified and concerted effort solve the problems which are vital to our business, in order that we may allow our industry to progress and fulfill our entire obligation to both the public and the industry and ultimately find ourselves in the proper realization of our rightful position—the greatest and most serviceable of all industrial institutions.

Issue Bonds

Denver, Col.—Harvey Fisk & Sons have issued a circular on Denver Gas & Electric Light Company first and refunding sinking fund 5 per cent bonds. The issue is a legal investment for savings banks in Maine, New Hampshire and Rhode Island.

Earnings Not Up to Estimates

Chicago, Ill.—Indications are that earnings by Peoples Gas Light & Coke Company this year will not be up to earlier estimates of $10 a share on 385,000 shares outstanding. This is due in large part to the fact that gas sales are not up to the estimated consumption of 30,000,000,000 cu. ft. of gas. Difference in amount of sale would mean slightly more than $3,000,000 in gross revenue.

Public Utilities Securities Market Report

Prices of Representative Gas Bonds

(Quotations furnished by The National City Company)

Company	Issue	Maturity	Oct. 20, 1921 Bid	Asked
American Lt. & Trac. Co.	Five Year 6s	May 1, 1925	91½	92½
Brooklyn Union Gas Co.	First Consol. 5s	May 1, 1945	83	85
Columbia Gas & Elec. Co.	First 5s	May 1, 1945	86½	88
Consol. Gas, Elec. Lt. & Pr. Co. of Baltimore	First Ref. 7½s	Dec. 1, 1945	99¾	101
Consol. Gas, Elec. Lt. & Pr. Co.	General 4½s	Feb. 14, 1935	76	77
Consol. Gas Co. of New York	Sec. Conv. 7s	Feb. 1, 1925	102¼	102¾
Consol. Gas Co. of New York	One Year Sec. 8s	Dec. 1, 1921	100	100¼
New Amsterdam Gas Co.	First Consol. 5s	Jan. 1, 1948	70	72
Denver Gas & Elec. Co.	Gen. (now 1st) 5s	May 1, 1949	78	80
Detroit City Gas Co.	Gold 5s	Jan. 1, 1923	92½	95
Equitable Illum. Gas Lt. Co. of Philadelphia	First 5s	Jan. 1, 1928	97	99
Hudson County Gas Co.	First 5s	Nov. 1, 1949	73	76
Laclede Gas Light Co.	Ref. & Ext. 5s	Apr. 1, 1943	83	85
Louisville Gas & Elec. Co.	First & Ref. 7s	June 1, 1923	97	99
Michigan Light Co.	First & Ref. 5s	Mar. 1, 1946	71½	73
Milwaukee Gas Light Co.	First 4s	May 1, 1927	82½	84
Pacific Gas & Elec. Co.	Gen. & Ref. 5s	Jan. 1, 1942	82½	83
Pacific Gas & Elec. Co.	Col. Tr. Conv. 7s	May 1, 1925	98	99½
Pacific Gas & Elec. Co.	First & Ref. 7s	Dec. 1, 1940	100	101
Cal. Gas & Elec. Corp.	Unif. & Ref. 5s	Nov. 1, 1937	89	91
Peoples' Gas Lt. & Coke Co.	Refunding 5s	Sept. 1, 1947	77¼	78
Chicago Gas Lt. & Coke Co.	First 5s	July 1, 1937	81	82½
Portland Gas & Coke Co.	First & Ref. 5s	Jan. 1, 1940	80½	82
Seattle Lighting Co.	Refunding 5s	Oct. 1, 1949	68	71
Southern California Gas Co.	First 6s	Nov. 1, 1950	85	89
United Gas Improvement Co.	Two Year 8s	Feb. 1, 1923	99⅝	100
Utica Gas & Electric Co.	Ref. & Ext. 5s	July 1, 1957	78½	81
Washington Gas Light Co.	General 5s	Nov. 1, 1960	81½	83
Western States Gas & Elec. Co. of California	First & Ref. 5s	June 1, 1941	77	81

Bonds ranged in price between 95¼ and 101⅝ during the period 1910-1916.

Rochester Gas & Electric 5s

Rochester, N. Y.—One of the better investment opportunities among the public utility bonds not listed at New York, and selling at a price to yield between 6 and 7 per cent, is the issue of Rochester Railway & Light Company (now Rochester Gas & Electric Corporation) consolidated mortgage 5s, due in 1954. A yield of 6.65 per cent if held to maturity, or a current return of 6.39, may be had at the present price around 78¼.

There are $10,941,000 of the bonds outstanding, and they are traded in quite actively here, although not listed on the New York Stock Exchange.

The loan is a general lien upon all of the company's property, subject only to $1,400,000 prior liens which will be retired by 1942 through provisions already made. It is also a first lien upon all improvements and betterments which may be made to the property in the future up to the loan's maturity.

The company has reserved the right to recall the bonds at 110 on any interest date. Consolidated mortgage 5s are available in $1,000 denomination only, but investors who are impressed with the company's showing may obtain a smaller denomination from the general mortgage 7 per cent loan reviewed below.

Oklahoma Gas & Electric 5s

Oklahoma City, Okla.—Investors who want a short-term public utility bond of good grade giving a relatively high return may consider Oklahoma Gas & Electric Company's first mortgage 5s, due in 1929. A yield of 7.80 per cent if held until maturity, or a current return of 5.98, may be had at the present quotation around 83½.

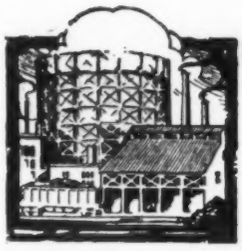
The loan is not listed on the New York Stock Exchange, but bonds are available over the counter. The $2,788,000 outstanding are a first mortgage on the company's entire property. Bonds are redeemable at 102½. An amount equal to 5 per cent of the bonds outstanding is set aside each year by the company as a depreciation and renewal fund.

Will Not Pay Commission

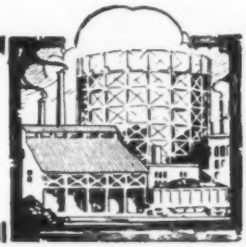
Turlock, Cal.—Up to a year ago the city of Turlock had been receiving a 2 per cent commission on the gross receipts of the Pacific Gas & Electric Company for the company's franchise to supply the city with light and power, but this year the company refused to pay on that basis and they sent their check for 2 per cent on the power earnings only. The city objected to that arrangement and referred the matter to their attorney who has advised that he has been unable to establish the rights of the city to the major amount.

Stockholders' Special Meeting

Haverhill, Mass.—Haverhill Gas Light Company, a Stone & Webster property, has called a special meeting of stockholders to consider increasing capital stock by $146,250, through issuance of 2,925 additional shares of $50 par. Proceeds are to be applied to payment of outstanding indebtedness and to other purposes.



NEWS OF THE GAS INDUSTRY



Gas Managers Meet

Boston, Mass.—The managers of all the public utility companies under the management of Stone & Webster have just concluded a convention in Boston. Forty-three such companies were represented and some managers came all the way from the Pacific Coast to attend. The matter of public relations proved the central topic of discussion at the conference. It is felt by the management that the engineering and operating features of street railway, electric light and gas service have reached such a stage of perfection now that difficulties are most likely to arise from the failure of human relations rather than from mechanical defects. In this connection, Samuel S. Kennedy, vice-president of the Southern California Edison Company, who has been the guest of the Stone & Webster management during the week, made an address which proved a notable feature of the convention.

Abundance of Gas for Texas Cities

Fort Worth, Texas.—Fort Worth, Dallas and all north Texas cities receiving gas service from the Lone Star Gas Company through local distributing companies will have an abundant supply of gas, not only for the coming winter months but for a year or more at least, is the opinion of F. L. Chase, manager of the gas department of the Lone Star.

According to Mr. Chase, the company has at the present time 1,000,000,000 cu. ft. of open-flow gas connected with its different mains. All of this gas is available for consumption by north Texas cities served by the company. For several months past the company has been making extensions and have now completed a second sixteen-inch main into the Duncan, Okla., field. The company has also completed its ten-inch extension from the South Duncan to the North Duncan field, with laterals running to the different wells.

Since last spring the Lone Star has laid between ten and fifteen miles of pipe line in the Palo Pinto field covering the Brazos district. These lines were laid to connect up new gas wells developed there during the early summer. With all of the completions and the mains now in service the Lone Star has a delivering capacity of 135,000,000 cu. ft. of gas per day. This gas is being distributed through north Texas by distributing gas companies in each city. Fort Worth and Dallas are the big consumers and either city will use more gas than practically all other cities combined on the lines.

According to Mr. Chase, the sixteen-inch lines have a daily capacity of 40,000,000 cu. ft. per day and the eighteen-inch line which goes into the west Texas fields has a capacity of 55,000,000 cu. ft. The total maximum consumption in Fort Worth and Dallas combined per day is around 55,000,000 cu. ft. Mr. Chase is also authority for a statement that his company is now in position to serve industrial plants for at least one year in advance of the present time.

Lowell Votes "No" on Municipal Ownership

Lowell, Mass.—At the special election the proposition to have the city of Lowell purchase and maintain the plant of the Lowell Gas Light Company was defeated, 4,722 to 8,819 against.

Returns of the Lowell Chamber of Commerce referendum on the question, "Do you favor the establishment of a municipal gas plant in Lowell, either by the construction of such a plant or by purchase of the Lowell Gas Light Company's plant?" were 447 no, 16 yes. Although not 50 per cent of the membership replied on the question, the number of returns made was considered sufficient for a definite opinion by the officials.

Reduces Gas Rate

Pawtucket, R. I.—Consumers of gas furnished by the Blackstone Valley Gas & Electric Company will be able to buy that product at a reduction of 10 cents per thousand cubic feet beginning Nov. 1, according to a schedule of rates filed by the company. The reduced cost of gas manufacture has enabled the Pawtucket plant to take this action, and a promise is made of further reduction to consumers, if conditions warrant it.

The statement reads as follows:

"Oct. 11, 1921.

"Rhode Island Public Utilities Commission, State House, Providence, R. I.:

"Gentlemen—In our communication of Aug. 23, 1920, regarding our rates for gas sold in the Blackstone Valley, we stated that when reduction in the cost of manufacture warranted a decrease in the prices charged for gas we would reduce our rates. We are now able to purchase material at a lower cost than previously and we take pleasure in announcing a reduction in the rates of gas to all consumers, effective for gas sold on and after Nov. 1, 1921.

"The rate for regular meters will be as follows:

"First 4,000 ft. per month at $1.30 net per thousand cubic feet.

"Next 10,000 cu. ft. per month at $1.20 net per thousand cubic feet.

"Balance per month at $1.10 net per thousand cubic feet.

"Service charge 50 cents per month.

"Should a further reduction in cost of materials, labor and taxes or an increase in the use of gas reduce our operating expenses per thousand feet sufficiently to make possible a further reduction in rates, one will be made.

"We are filing herewith new gas rates and respectfully request that you waive the customary thirty days-notice in order that these may become effective Nov. 1, 1921.

"Yours very truly,

"Blackstone Gas & Electric Co.

"By Gardner Rogers, Manager."

Hearing Set for Oct. 25

Jefferson City, Mo.—The State Public Service Commission has set the continuation of the gas company rate case for Oct. 25 at Jefferson City.

The city presented its evidence at a hearing here and asked that the rate for manufactured gas be lowered from $1.60 a thousand cubic feet to $1.30 a thousand, minus the service charge which is now in effect. The service charge ranges from 50 cents to $1.25 a month. The city proposes a minimum charge of 50 cents a month.

An attempt is also being made to force the local company to distribute natural gas to be furnished by the Kansas Natural Gas Company. It was brought out in the hearing here that enough gas could be furnished to supply the city between April and October of each year or during the summer months. For the remainder of the year it probably would be necessary to supplement the natural supply with the manufactured product.

The gas company will present its side at the hearing at Jefferson City. As a result of the reopening of the rate question, the company has intimated that it will ask for a new valuation of the plant.

Tenney Service Convention

The twelfth annual Tenney Service Convention was held in Boston, Mass., at the Engineers' Club, Oct. 10, 11 and 12.

This convention brought together about 250 delegates representing companies under the management of Charles H. Tenney & Co.

Governor Cox of Massachusetts addressed the delegates at the luncheon on Oct. 11. The convention was brought to a successful close by an outing to Suntang Lake Inn, Lynnfield, Mass.

The program was as follows:

MONDAY, OCT. 10, 1921

11.30 A. M. to 12.30 P. M.—Registration.
2.30 P. M.—First session. Engineers' Club, 2 Commonwealth Avenue.
Presiding Officer—H. T. Sands.
Opening Address—Colonel Charles H. Tenney.
"Public Utility Organizations"—M. H. Aylesworth, executive manager, National Electric Light Association.
"The Whirl of the World"—W. Irving Bullard, vice-president, Merchants National Bank, Boston.

TUESDAY, OCT. 11, 1921

10 A. M.—Second session.
Presiding Officer—D. E. Manson.
"The Tenney Organization"—Palmer York.
"Good Housekeeping (and Bad)"—A. E. Bliss.
"The Trend of Public Utility Legislation"—Allen Hollis.
"Present-Day Public-Utility Obligations"—H. T. Sands.

TUESDAY, OCT. 11, 1921

2.30 P. M.—Third session. Engineers' Club.
Presiding Officer—A. B. Tenney.
"Health and Efficiency"—Dr. Martin Edwards, Boston, Mass.
"The Constitution Our Safeguard"—Hon. Harry F. Atwood, Chicago, Ill.

The companies represented were: American Tar Company; Boston Electrolytic Oxygen Company; Concord Electric Company; Eastern Massachusetts Electric Company; Exeter & Hampton Electric Company; Fitchburg Gas & Electric Light Company; Haverhill Electric Company; Malden Electric Company; Malden & Melrose Gas Light Company; Montpelier & Barre Light & Power Company; People's Gas & Electric Company of Oswego; Rockland Electric Company; Rockland Light & Power Company; Salem Electric Lighting Company; Springfield Gas Light Company; Suburban Gas & Electric Company; the Bristol & Plainville Electric Company; Charles H. Tenney & Co.; Worcester Gas Light Company.

City Will Not Drill for Gas

Buffalo, N. Y.—Commissioner Arthur W. Kreinheder, Department of Public Works, stated that his survery report on the local gas proposition pertaining to the city drilling for gas and also going into the manufactured gas business will be ready for the council shortly. Just what this report would be the commissioner refused to state, except to say it would be a report fully covering the situation.

A meeting was held in the commissioner's office with City Engineer George Counsel Rupp and the city's gas expert, Benjamin J. Hatmaker. While Commissioner Kreinheder does not want to make any statements until he submits his report to the council, it can be stated on good authority that the city will not drill for gas, but may consider the matter of manufacturing artificial gas in what is known as a coke oven plant.

The survey which Commissioner Kreinheder is making is the result of a resolution adopted by the council some months ago authorizing the commissioner to investigate natural and artificial gas propositions. The council appropriated $50,000 for this work.

Construction Notes

Reports current are that the Allied Power Industries, of Columbus, Ohio, will erect a gas plant at their coal mines in Tuscarawas County, Ohio. The new plant will be of 50,000,000 cu. ft. capacity and will relieve the natural-gas shortage in that vicinity.

From Basin, Wyo., the announcement comes that the Wyoming Gas Company will commence work in the spring on a gas line from Little Buffalo Basin to Basin. The route of the new line will permit the construction of a feeder from the Oregon Basin field, thirteen miles in length and with these completions a continuous series of pipe lines will connect the fields of the Big Horn Basin. The Wyoming Gas Company is the distributing agency for the Ohio gas marketed from the Hidden Dome.

Want Rate Increase

Charleston, W. Va.—Application of the Hope Natural Gas Company, of Pittsburgh, to increase industrial gas rates in a number of northern West Virginia counties was heard by the Public Service Commission. The application is being protested by the Powers Pottery Company, of Mannington. The commission announced all other protestants have withdrawn objections previously filed.

Want Better Street Lights

Westboro, Mass.—Westboro business men, particularly merchants, are agitating bigger and better lights in the business district and have already taken the matter up with the selectmen and Westboro's gas and electric company. Westboro's main street, through the center of the town, part of South, Mills and Summer Streets, should be better lighted. What the business men want is more candle-power. Some are talking strongly of all-night lights.